The Agroforestry Demonstration Program in the San Joaquin Valley

Progress Report

March 1988

Prepared under contract for the
FEDERAL-STATE
SAN JOAQUIN VALLEY DRAINAGE PROGRAM
By the
CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE

This progress report presents the status of research activities being conducted for the Agroforestry Demonstration Program by the California Department of Food and Agriculture and the U.S. Department of Agriculture's Soil Conservation Service. The report was prepared under provisions of a cooperative agreement for the Federal-State San Joaquin Valley Drainage Program, one of the funding entities sponsoring the demonstration project. Publication of the findings and recommendations included in the report should not be construed as representing the concurrence of any Federal or State agency participating in the San Joaquin Valley Drainage Program. Also, mention of trade names or commercial products does not constitute endorsement or recommendation by the agencies. The purpose of this report is to provide the Drainage Program agencies with information and alternatives for further consideration.

The San Joaquin Valley Drainage Program was established in mid-1984 as a cooperative effort of the U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, U.S. Geological Survey, California Department of Fish and Game, and California Department of Water Resources. The purposes of the Program are to investigate the problems associated with the drainage of irrigated agricultural lands in the San Joaquin Valley and to formulate, evaluate, and recommend alternatives for the immediate and long-term management of those problems. Consistent with these purposes, Program objectives address the following key areas: (1) Public health, (2) surface- and ground-water resources, (3) agricultural productivity, and (4) fish and wildlife resources.

Inquiries concerning the San Joaquin Valley Drainage Program may be directed to:

San Joaquin Valley Drainage Program
2800 Cottage Way, Room W-2143
Sacramento, California 95825-1898

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and other contributing agencies

Under

U.S. Bureau of Reclamation
Cooperative Agreement No. 7-FC-20-04900

By the

California Department of Food and Agriculture
Agricultural Resources Branch
1220 N Street, Room 104
Sacramento, California 95814

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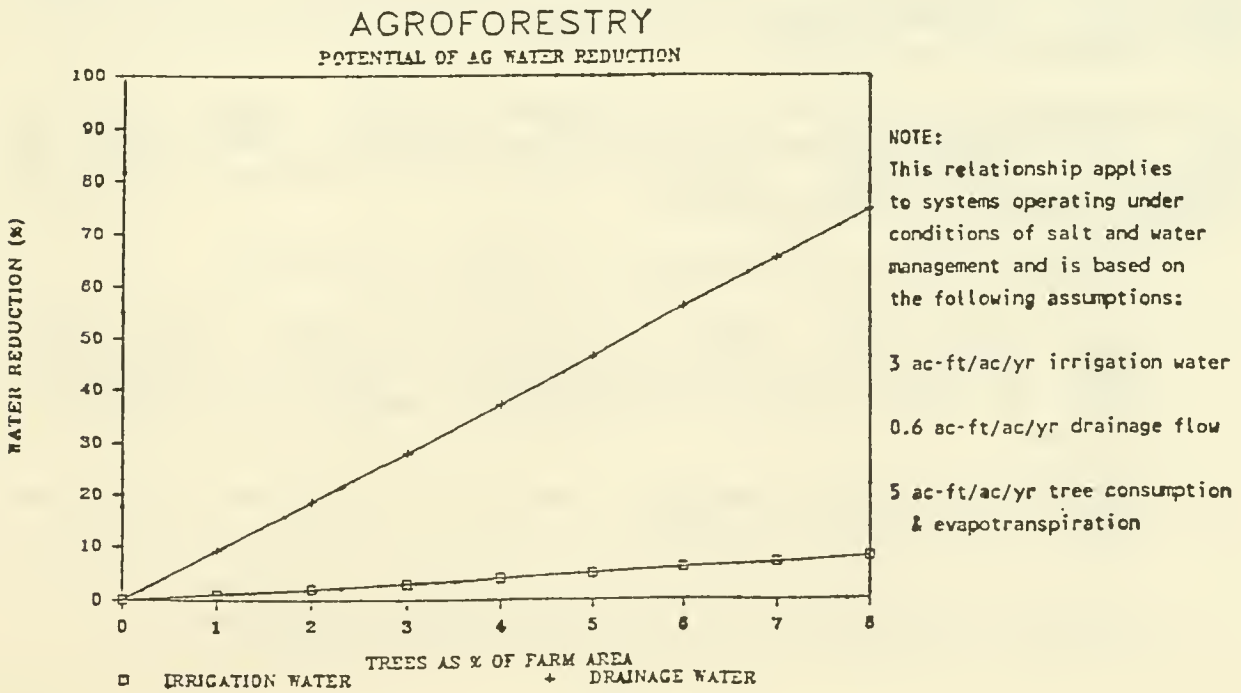
EXECUTIVE SUMMARY

The California Department of Food and Agriculture (CDFA) and the United States Department of Agriculture - Soil Conservation Service (USDA - SCS) are currently conducting research on the potential use of agroforestry as an option to help San Joaquin Valley farmers manage drainage water and salinity problems. The use of agroforestry for this purpose is based on salinity management practices used in world regions with soil and climatic conditions similar to those in California.

Irrigation of farmland creates the need to leach accumulated salts from the soil in order to allow the continued production of crops. Problems in the San Joaquin Valley involve shallow ground water tables created when saline water accumulates above low-permeable clay layers in the soil. These high water tables must be lowered below crop root zones in order to prevent losses in production. Additional problems involve potentially harmful elements, such as selenium and boron, which may be contained in this saline water.

The Agroforestry Demonstration Program currently underway is testing and evaluating the feasibility of utilizing trees to reduce the amount of agricultural drainage water generated within the San Joaquin Valley. Salt-tolerant trees have the potential to lower the water table and reduce the volume of this drainage water through evapotranspiration and consumptive uses. Agroforestry can therefore lower the costs of drainage water management by reducing the amount of water which must be treated and/or disposed of in evaporation ponds, solar ponds, or deep-injection wells. Figure 1 illustrates the potential of the agroforestry system to reduce both the volume of drainage water and the volume of irrigation water used on farms in the San Joaquin Valley.

FIGURE 1



The trees can contribute to more than just the reduction of water volume. They can also help increase the production of conventional crops by lowering high water tables. Additionally, the trees, in combination with selected plants grown as biofilters, may help remove some of the selenium and other elements from the drainage water. The trees and biofilter crops, irrigated with drainage water on a given percentage of land, would also reduce the total requirements for irrigation water supplied by canals and rivers (for example, a 100 acre farm with 10% agroforestry would require fresh irrigation water for only 90 acres of crops). Consequently, agroforestry would also reduce the amount of salts brought into the San Joaquin Valley with fresh water deliveries.

In addition to assisting farmers with the management of drainage and salinity problems, the trees can also provide: (1) a marketable commodity in the form of harvested biomass, (2) windbreaks, (3) a wildlife habitat amid flat farmland, and (4) an opportunity for farmers to gain additional income from beekeeping or establishing hunting areas for sportsmen.

Fast-growing eucalyptus and casuarina trees may produce up to 15 to 20 tons biomass per acre per year, although under saline conditions yields can be expected to be lower, yet still substantial, amounts. The plantations are still too young at this point to determine actual yields, but it is apparent that land which might otherwise be either not cultivated or kept as evaporation ponds can instead be utilized productively. The plantations may also help the farmer by providing effective windbreaks to help protect adjacent crops and reduce soil erosion.

The wildlife study being conducted as part of this program indicates that many birds and small mammals are using the trees for shelter. The study will continue to determine the wildlife uses of the plantations as well as the possible effects of the drainage water irrigation on wildlife. Farmers may also obtain additional income through the management of the plantations for game hunting or bee hives.

The demonstration plantations, planted in 1985, 1986, and 1987, are now becoming mature enough so that positive results can be observed. Preliminary analyses of the data obtained from the program thus far indicate that:

1. Drainage water can be used to irrigate the trees.

2. Once established, trees can use ground water from higher water tables and do not need to be irrigated; planting of trees as water flow interceptors needs to be further studied.

3. Trees can be used to manage a water/salt balance; the system needs to be further studied.

4. Trees are growing at rates of 1/3 foot to 2/3 foot or more per month, depending on soil and growing conditions.

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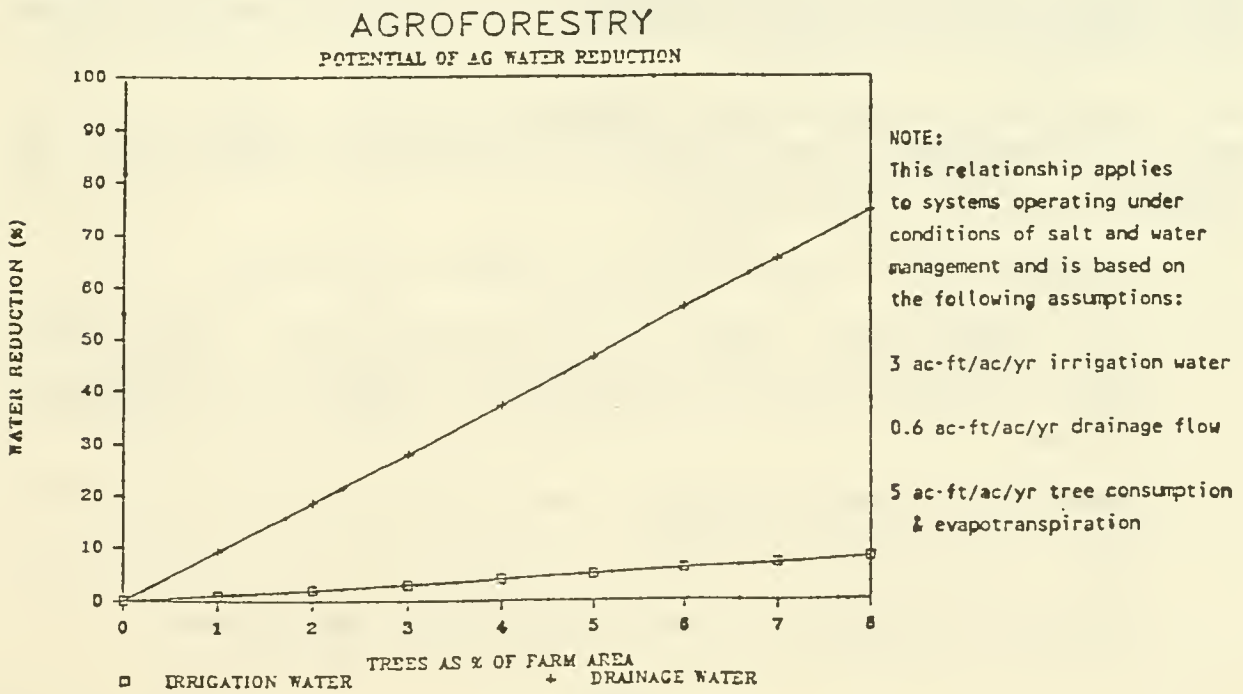

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3. Trees can be used to manage a water/salt balance; the system needs to be further studied.

4. Trees are growing at rates of 1/3 foot to 2/3 foot or more per month, depending on soil and growing conditions.

5. Tree plantations attract wildlife; the interaction of plantations and wildlife needs to be further studied from both economic and ecological standpoints.

6. Trees can recover from the damage of cotton defoliants.

7. Weed control is needed mostly during the first year.

8. Tree production may be a low cost operation, especially considering the economic aspects of drainage water management.

9. Trees offer an opportunity for economic use of land.

10. Power and pulp companies are expressing an interest in contracting with growers for supplies of biomass; composition of the biomass and environmental effects of its conversion need to be studied.

11. Trees and biofilter plants may provide an opportunity to diversify production and marketing options.

12. Biofilter crops potentially uptake selenium; the feasibility of using "selenium enriched" forage for livestock needs to be studied.

The challenge of salinity and drainage water problems needs to be addressed at the on-farm level. The solution can be found in a combination of measures, such as irrigation management, agroforestry, biofilter crops, and water treatment or disposal facilities, all of which would operate as a system. This approach may also offer an opportunity to manage selenium and other elements as resources rather than hazardous waste.

The goal of the Agroforestry Demonstration Program is to develop a practical farming solution to drainage and salinity problems in order to maintain the viability of the agriculture industry in the San Joaquin Valley.

* * *

Acknowledgement

The Agroforestry Demonstration Program has been partially funded by the San Joaquin Valley Drainage Program (SJVDP) and the State Water Resources Control Board (SWRCB). The California Department of Forestry (CDF) has been supplying a portion of the seedlings required and the Department of Water Resources (DWR) has committed additional financial support for the program. The United States Department of Agriculture - Soil Conservation Service (USDA - SCS) and the California Department of Food and Agriculture (CDFA) enjoy the cooperation of farmers and numerous professionals working in the private sector, federal and state agencies, and universities. This report was produced in order to document the progress of the San Joaquin Valley Agroforestry Demonstration Program for the San Joaquin Valley Drainage Program, in compliance with the agreement between the CDFA and the United States Bureau of Reclamation, and for other interested individuals and agencies.

* * *

1.0 Introduction

The agroforestry demonstration program for the management of saline drainage water was introduced in the San Joaquin Valley during the spring of 1985 and is scheduled to continue through at least 1991. Twenty-one trial plantations, ranging in size from less than one acre to 28 acres and totaling about 179 acres, include plantings of eucalyptus, casuarina, poplar, mesquite, and Elderica pine. These trial plantations are located on private farms. Seeds for Eucalyptus camaldulensis, the most commonly planted species of eucalyptus, were obtained from the Lake Albacutya, Mt. Bernstead, and Alice Springs areas of Australia. Casuarina seeds were obtained from both Australia and Egypt. The poplar cuttings and mesquite seedlings were obtained from two commercial nurseries and the University of California, Riverside.

Fresh water is used to irrigate the seedlings during the first year in order to establish the trees. Thereafter, the trees receive saline drainage water and/or they directly utilize ground water from high water tables. The level of weed control varies from farm to farm, as does the application of fertilizers and amendments. The trees show hardy growth under a variety of conditions and have problems only in the most highly saline areas of some fields.

A comprehensive 5-year program has been implemented for monitoring the soil, water, and plant conditions. Levels of ground water are measured at regular intervals and laboratory tests are conducted on samples of soil, water, and plant tissues. The California Department of Food and Agriculture (CDFA), the U.S. Department of Agriculture - Soil Conservation Service (USDA-SCS), and the California State University, Fresno - Center for Irrigation Technology (CSUF-CIT) gather the monitored data. The farm reports (Sections 4.0 through 4.13) show some of this data, including planting history and the depth of ground water and its electric conductivity. The trends of the monitored data are continuously analyzed. Tabular and graphical presentations of some of these results are included in several of the farm reports. Contracts have been signed with Dellavalle Laboratories, Inc., for analysis of soil, water, and plant tissue samples and CSUF-CIT for water monitoring.

In March of 1987 a report on the agroforestry program was presented at the Pacific Region Meeting of the American Society of Agricultural Engineers in Tucson, Arizona. This report, along with additional information on the agroforestry program, can be found in the April 1987 progress report, available upon request from the Agricultural Resources Branch of the CDFA.

* * *

2.0 Present Status of the Agroforestry Demonstration Program

As mentioned previously, the Agroforestry Demonstration Program includes approximately 179 acres of trees planted on 21 farms. Table 1 lists the size and county of participating farms along with planting information and portions of the program in which each farm participates. The map in Section 4.0 indicates the locations of the individual farms and the farm reports in Sections 4.1 through 4.13 give more detailed accounts of the plantings. Typical eucalyptus and casuarina trees are shown in the photographs in Figure 2.

In addition to the trial field plantings, which include monitoring and laboratory analyses of soil, water, and plant samples, the Agroforestry Demonstration Program is conducting research studies on other aspects of agroforestry. All of these activities are oriented toward the successful integration of agroforestry farming practices in the San Joaquin Valley. These projects include:

1. the selection and propagation of superior performing trees (Section 5.0)

2. the economic analysis of agroforestry and marketing of value-added agroforestry products (Section 6.0)

3. the study of the wildlife uses of the plantations, the economic and other values of the wildlife, and the potential effects of contaminants in drainage water on this wildlife (Section 7.0)

4. the study of the salt and water balance of the system (Section 8.0)

5. the study of biofilter crops for the management of drainage water within the framework of agroforestry and of livestock feeding trials with harvested forage in selenium deficient areas (Section 9.0)

6. the study of biomass characteristics, the distribution of elements, such as selenium, within the biomass, and the ultimate destiny of these elements after biomass utilization (potential for air pollution, etc.)

Contracts have been signed between the CDFA and the University of California, Davis (UCD) and California State University, Fresno (CSUF) to perform these research studies. The University of Arizona (UA), Tuscon is involved in the biofilter study. The biomass study is scheduled to start in 1988 at UCD.

TABLE 1 Agroforestry Program Demonstration Plantations

FARM	COUNTY	ACREAGE IN TREES	YEAR PLANTED			TYPES OF TREES PLANTED					DETAILED LABORATORY ANALYSES			USDA-SCS WATER TABLE MONITORING		INTENSIVE WATER MONITORING (CSUF)	WILDLIFE STUDY	WATER/SALT BALANCE STUDY	SELECTION OF TREES FOR PROPAGATION		HALOPHYTE BIOFILTER TRIAL
			1985	1986	1987	Euc	Cas	Pop	Mes	Pine	Soil	Water	Plant Tissue	Depth	EC				1987	1988	
Murrieta	Fresno	23.3	X	X		X	X	X			X	X	X	X	X	X	X	X	X	X	X
Peck	Fresno	8.2	X	X		X	X				X	X	X	X	X	X	X		X	X	
Thomsen	Fresno	15		X	X	X	X				X	X	X	X	X	X	X			X	
Allen	Fresno	5		X		X	X							X	X	X	X			X	
Gowen	Fresno	1		X		X	X														
Meyers	Fresno	28			X	X															
Verdigaal	Kings	8		X	X	X	X				X	X	X	X	X						
Carollo	Kings	10		X	X	X	X			X	X	X	X	X	X					X	
Haynes	Kings	11.3		X	X	X	X	X	X					X	X		X			X	
Kings Boys Ranch	Kings	2		X		X															
Stratford P.U.	Kings	7			X	X															
Orton	Kings	4			X	X															
Tulare Lake D.D.	Kings	3.4			X	X	X														
Stanton	Kings	2			X	X															
Rowan	Kings	2			X	X															
Rio Vista	Kings	1.2			X	X															
Van Groninger	Kings	<1			X	X															
Buttonwillow	Kern	4.5		X		X					X	X	X	X	X					X	
Bloemhof	Kern	19		X		X	X							X	X						
Williams	Kern	13		X		X	X		X					X	X						
Way	Kern	12		X		X		X			X	X	X	X	X					X	
		-------																			

21 Farms, Total Acreage = 179.9 acres

FIGURE 2

San Joaquin Valley Field Sites for the
Agroforestry Demonstration Program

EUCALYPTUS TREES

CASUARINA TREES

Funding for these research projects and the field trials and associated analyses has been obtained from grants by the CDFA, the USDA-SCS, the Federal - State San Joaquin Valley Drainage Program (SJVDP), the State Water Resources Control Board (SWRCB), and the Department of Water Resources (DWR). The California Department of Forestry (CDF) has contributed over 80,000 seedlings to the program, with a cash value of approximately $32,500. Table 2 lists the contributions of these agencies and Table 3 shows the activities supported by each of the funding sources, along with the names of the contracted institutions and the investigators.

The CDFA has been keeping records on the expenditures and reimbursements for the previously mentioned activities. Financial summaries for this information are included in Section 10.0.

Other agencies are also supporting the Agroforestry Demonstration Program with contributions such as supplying seedlings or providing consulting services. All of the participants and their activities are included in Table 4. Section 11.0 contains a directory of the individual Agroforestry Program participants.

TABLE 2 Funding for the Agroforestry Program
(October 1987)

FUNDING AGENCY	CONTRIBUTION
CDFA	$ 95,000
SJVDP	60,000
SWRCB	50,000
USDA-SCS	15,000
DWR	9,500
CDF	32,500 (equivalent)
total funding	$262,000

TABLE 3 Agroforestry Program Grants and Activities

FUNDING SOURCE	ACTIVITY	INSTITUTION OR COMPANY UNDER CONTRACT	INVESTIGATORS
CDF	Provide seedling	n/a	Gene Hartzel
SWRCB	Analysis of samples	Dellavalle Labs	n/a
	Seedling purchases	Contracted and non-contracted commercial nurseries	n/a
	Other field trial related expenses	n/a	n/a
SJVDP	Selection and propagation of trees	UCD	Dr. R. Sachs Dr. R. Woodward M. Merwin (ITCI)
	Economic study	UCD (direct salary payment)	Dr. J. Wilen Luanne Lohr
	Wildlife study	CSUF	Dr. D. Chesemore Andy Dyer
CDFA	Salt & water balance	UCD CSUF	Dr. K. Tanji Dr. S. Gratton Dr. K. Solomon Dr. G. Jorgensen
	Water monitoring	CSUF	Dr. K. Solomon Dr. G. Jorgensen
USDA-SCS	Analyses Equipment	USDA Laboratory Lincoln, Neb.	Fresno, Hanford & Bakersfield Offices
DWR	Evapotranspiration study	UCD	Dr. S. Gratton

TABLE 4 Participating Agencies

PARTICIPANT		ACTIVITIES
CDFA	-California Department of Food & Agriculture	-Administration -Funding -Consultation in plant pathology
USDA-SCS	-USDA-Soil Conservation Service	-Tree planting -Monitoring field trials -Funding -Relations with participating farmers
CDF	-California Department of Forestry	-Consulting -Seedlings
SJVDP	-Federal-State San Joaquin Valley Drainage Program	-Funding -Consulting
SWRCB	-State Water Resource Control Board	-Funding -Consulting
DWR	-Department of Water Resources	-Funding -Consulting
USBR	-U.S. Department of the Interior, Bureau of Reclamation	-Consulting
USFW	-U.S. Fish & Wildlife	-Consulting
USDA-FS	-USDA Forest Service	-Consulting -Economic study
CVRQCB	-Central Valley Regional Quality Control Board	-Consulting -Quality control in lab testing
DOC	-Department of Conservation	-Consulting
DFG	-Department of Fish & Game	-Consulting
UCD	-University of California, Davis	-Research
UCR	-University of California, Riverside	-Consulting -Seedlings

(continued on next page)

TABLE 4 Participating Agencies (continued)

PARTICIPANT		ACTIVITIES
UCB	-University of California, Berkeley Dept. of Forestry	-Consulting
CSUF	-California State University, Fresno	-Research -Consulting
	-CSUF Experimental Range Station	-Consulting -Use of Se enriched forage
UA	-University of Arizona	-Research -Consulting
CFF	-Chapman Forestry Foundation	-Consulting -Seedlings
ITCI	-International Tree Crop Institute	-Seeds -Assist in propagation of casuarina

* * *

3.0 Future Plans for the Agroforestry Demonstration Program

The agroforestry system needs to be tested and evaluated over several growing seasons. It is scheduled to continue through at least 1991, at which time the field plantations will have begun to reach maturity and all of the individual projects should be completed. Trees and biofilter crops will be harvested and analyzed for yield, composition, contaminants, economic value, and regrowth efficiencies. This program will develop practical field data on the agroforestry system, including information on agricultural water management and salinity control, integration of agroforestry with technologies for final treatment or disposal of drainage water, guidelines for the management of the plantations and biofilters, establishment of seed plantations, the processing of biomass into marketable commodities, and the development of markets for these products. Workshops will be organized and literature will be prepared to help disseminate this information to the farmers. The program also includes studies to investigate the environmental effects of the agroforestry system on wildlife and farming.

The goals of the Agroforestry Demonstration Program will be accomplished with the following activities:

- continue the detailed laboratory analyses of water, soil, and plant tissue on selected farms
- expand the quality assurance program for laboratory analyses
- continue intensive monitoring of water conditions on selected farms
- continue analysis of the monitored data from the demonstration plantations
- continue the economic and marketing study
- conduct the water/salt balance study, including the investigation of evapotranspiration characteristics of trees and biofilter crops
- continue selection of outstanding trees on farms which have been irrigated with drainage water for more than one year
- further test the selected trees in the laboratory
- propagate these trees and establish seed plantations in the San Joaquin Valley in order to have a local material source for further expansion of the plantings
- continue the wildlife study, including monitoring the wildlife in tree plantations of different ages, analyzing for contaminants in wildlife and their food chains, and

evaluating the economic value of agroforestry for additional income from hunting

- test halophytes as biofilters for uptake of selenium, and conduct feeding trials to investigate potential uses of the biofilter crops as selenium enriched forage for livestock in those areas of California which are selenium deficient

- characterize the biomass for its potential for conversion into marketable products, including the technology and economics of the conversion and the environmental impacts of biomass production and utilization

- coordinate with SWRCB, SJVDP, Westlands Water District, and other agencies the integration of agroforestry farming methods with the technologies considered for final removal and disposal of the salts concentrated in the reduced volume of drainage water

- study the feasibility of handling selenium and other elements (contained in the drainage water) as resources rather than waste materials

- organize workshops and prepare literature on agroforestry and its potential to help San Joaquin Valley farmers with the management of irrigation and drainage water and the development of marketable commodities

The Agroforestry Demonstration Program consists of several interrelated projects coordinated towards finding a practical farming solution to drainage and salinity problems. This program will help keep farming viable and will support the development of a new agriuclture-based industry in the San Joaquin Valley.

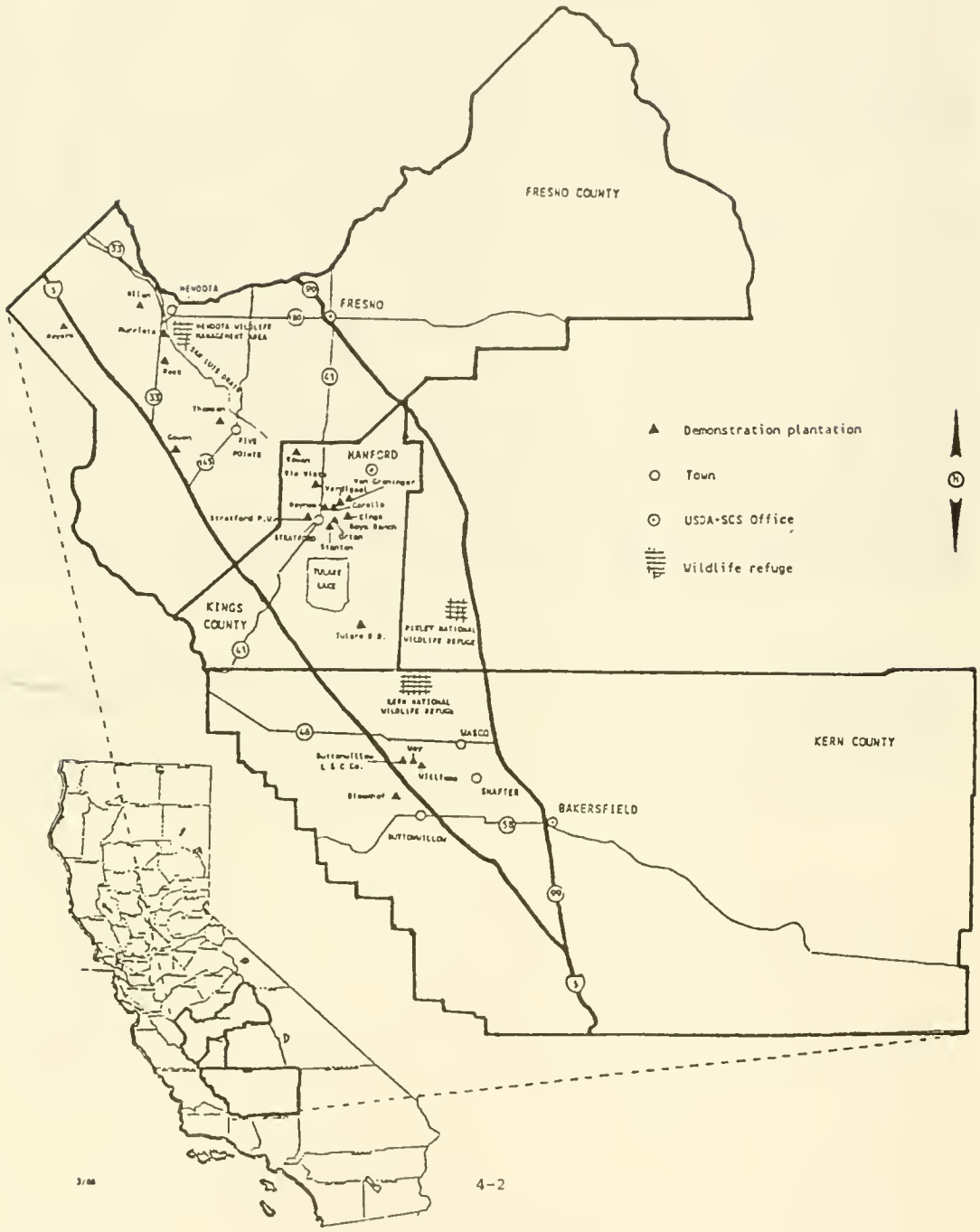
* * *

4.0 Progress of the Field Trials

Thus far, trees planted for the agroforestry program have shown rapid growth, with average heights of 4 to 7 feet in their first six months of growth. Some outstanding trees, usually growing in the better soils, stand 10 feet high or more when six months old. Other trees have suffered from problems such as highly saline soils or ground water or damage from the drift of cotton defoliants. Hot weather and lack of immediate irrigation at planting time caused high mortality of seedlings planted on some farms late in the season. From these experiences guidelines are being developed for planting and care during the first year so that seedling mortality can be reduced. Once established, the trees seem to thrive, even those with minimal care, and the trees suffering from cotton defoliant damage have surprisingly sprouted vigorous new growth.

The apparent low maintenance requirements indicate that the production of these trees is a low cost operation. Weed control is needed mostly during the first year. After this the trees seem to out-compete the weeds. The trees also seem to maintain high growth rates even while being irrigated with saline drainage water of up to 10,000 ppm TDS. The demonstration plantations have created an interest among farmers, some of whom wish to plant more trees. The effects of varying degrees of care and soil conditions on tree growth can be observed in the following farm reports (Sections 4.1 through 4.13), the first nine of which include brief summaries of the plantations.

SAN JOAQUIN VALLEY
AGROFORESTRY DEMONSTRATION PROGRAM
PLANTATION LOCATIONS



4.1 Murrieta Farms

Murrieta Farms has put much effort into their 24 acres of agroforestry plantings and thus they exemplify an intensively cared for plantation. The field site, which includes 1985 and 1986 plantings of several species and seed sources of eucalyptus, casuarina, and poplar, has been both hand weeded and sprayed with herbicides (both Fusilade and a mixture of Goal and Roundup). The lower lateral limbs are pruned and the trees have received some fertilizer. Although fresh irrigation water was used during the first year of growth, the trees now receive drainage water diluted with fresh water to reduce the salinity to approximately 10,000 ppm. The trees are growing well and typical trees have been harvested to determine the biomass yield.

The USDA-SCS in Fresno has provided soil and water analyses on Murrieta Farms. Detailed analyses have been run on soil and water samples. These are included in the following farm report. In addition to the detailed analyses, monthly readings of water table depth and electric conductivity (EC) of ground water are taken by CSUF - CIT.

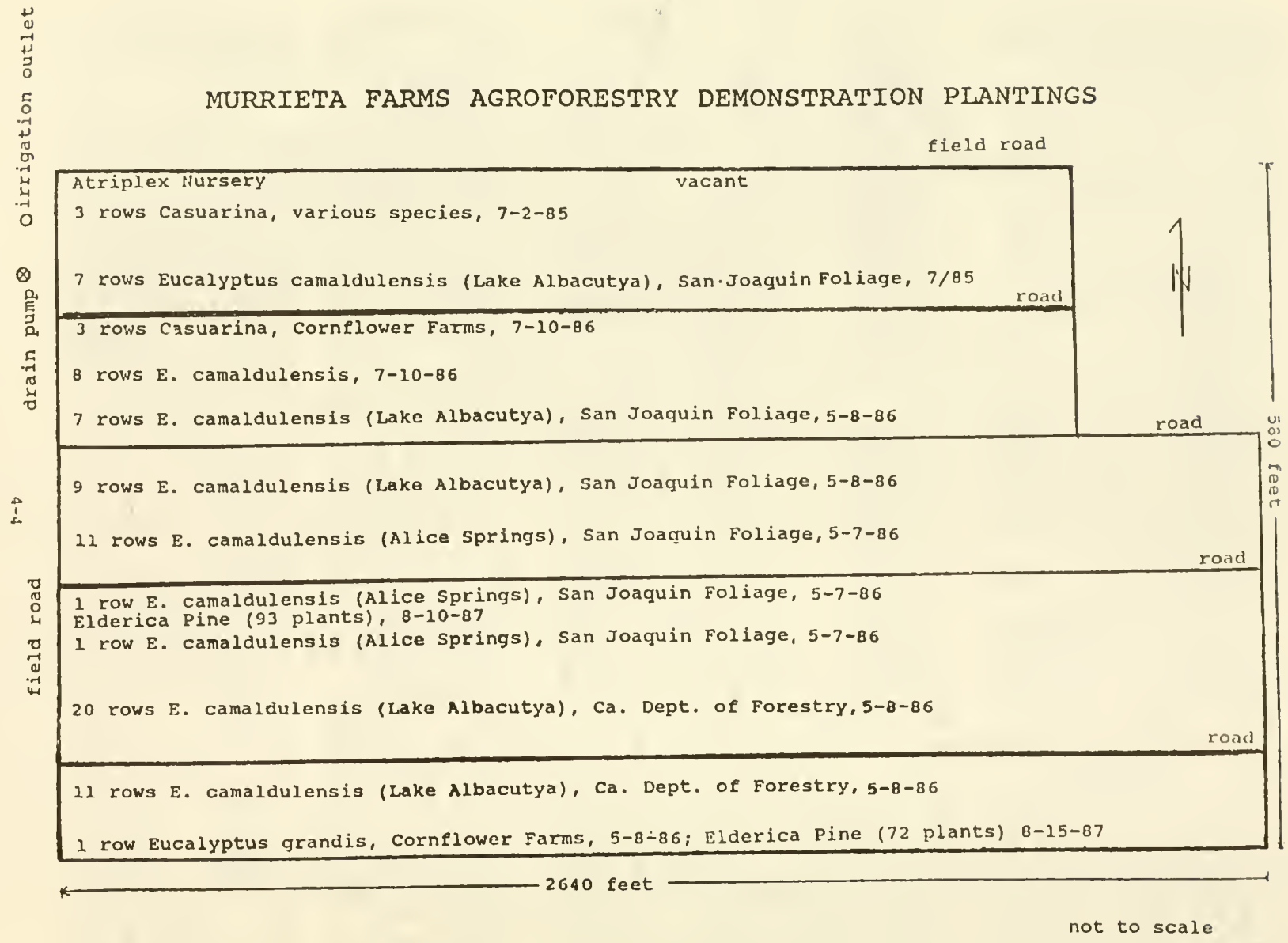
Several of the fastest growing trees have been harvested to provide cuttings for the tree selection and propagation trials at UCD. This project is further described in Section 5.0.

This plantation is also included in the wildlife study being conducted by the CSUF - Department of Biology. Many birds and small mammals have been seen in the area and several bird nests have been found in the casuarina trees. Refer to the report in Section 7.0 for a more complete description of this program.

A field of saltbush (Atriplex) was planted on the farm in cooperation with the University of Arizona (UA). This has been harvested in two cuttings for a total production rate of about 3 tons per acre. The forage has been fed to sheep and cattle on the ranch, which appear to like the hay. Detailed analyses are being run to determine the constituents and nutritional value of the plants in order to determine their suitablity as a biofilter crop. A description of this project is included in Section 9.0.

Murrieta Farms has been chosen as the field site for the salt/water balance study being conducted by researchers at UCD, CSUF - CIT, and UA, Tucson. This research will help track the water, salts, and elements going into and coming out of the agroforestry system. A tile drainage system will be installed under the agroforestry and biofilter site in order to conduct the study. Evapotranspiration values of trees and biofilter plants will also be measured. A more detailed outline of this project is included with the Salt/Water Balance project description in Section 8.0.

MURRIETA FARMS AGROFORESTRY DEMONSTRATION PLANTINGS



AGROFORESTRY - TREE PLANTING disc: AGROFORESTRY file: AGFOMURI
last update 9/8/87

county: FRESNO

farm: MURRIETA acreage: 23.3 av.tr/ac: 1560

PLANTING DATE	NURSERY	SOURCE	EUCA-CAM	EUCA-oth	CAS-gla	CAS-cun	CAS-oth	POPLAR	MESQUITE	gr.tot.
		total:	32900	1085	0	138	855	1376	0	36354
7/2/85	CORNFL	ITCI					855			
7/22/85	CDF			285						
8/19/85	SJV	L.ALBACUT	3200							
2/24/86	CHAPMAN	FORSTER						415		
3/4/86	ZAPATTINI	4 VAR'S						961		
3/4/86	CORNFL	CHAPMAN				138				
5/7/86	SJV	L.ALBACUT	29700							
5/8/86	CORNFL	"ROSE GUM"		800						

	Mo./Yr.	3/87	7/87
Comments:		some frost damage on new growth, some trees staked Alice Springs 2' shorter than Lake Al., possibly crossed w/ E. globulus	2-yr-old tree roots in water table, no stress w/ reduced irrig.,

SOILS	Mo./Yr.	9/86	3/87	7/87
Lab Analysis: see MURISOIL & "Work Plan..." in file for site description		-	See May '86 analysis of soil before planting in MURISOIL	
Amendments:		-	none	
Fertilizer:		Foloplex applied in August '86	none	aerially applied urea @ 60lb/ac, no date results impressive

IRRIGATION WATER

	Mo./Yr.	1985	3/87	7/87
Lab Analysis:		-	after drains plugged ppm = 10,000-12,000	water to trees is ~7 to 9 ppt salts, Se hi in Spring bef. irrig.

Amount & Frequency:	yearly total of 16 acre feet for 3.5 acres	season total = 3 acft 6 irrigations

WATER TABLE

Depth (feet):

	23-Sep-85	09-Oct-85	21-Nov-85	19-Dec-85		10-Feb-86	24-Mar-86			
	Sep-85	Oct-85	Nov-85	Dec-85	Jan-86	Feb-86	Mar-86	Apr-86	May-86	Jun-86
WEST END	4.83	5.83	5.00	6.17		6.75	5.75			
EAST END	5.50	5.00	4.92	5.67		5.92	5.83			

				29-Oct-86		30-Dec-86	
	Jul-86	Aug-86	Sep-86	Oct-86	Nov-86	Dec-86	Jan-87
WEST END				5.50		5.92	
EAST END				5.50		5.75	

	26-Feb-87		16-Apr-87	27-May-87	23-Jun-87	20-Jul-87
	Feb-87	Mar-87	Apr-87	May-87	Jun-87	Jul-87
WEST END	8.67		5.00	3.58	4.42	5.33
EAST END	9.00		4.75	3.33	5.00	5.58

7/87 letter states that water table in area has lowered due to drains being blocked (court order), water table varies according to irrigation of nearby lands where drain blocked

Lab Analysis

Electric Conductivity (Ec) of Ground water

	23-Sep-85	09-Oct-85	21-Nov-85	19-Dec-85		10-Feb-86	24-Mar-86			
	Sep-85	Oct-85	Nov-85	Dec-85	Jan-86	Feb-86	Mar-86	Apr-86	May-86	Jun-86
WEST END	15.2	19.2	20.1	21.1		19.5	11.0			
EAST END	6.4	6.4	7.8	6.4		11.3	3.3			
SAMPLE #026									22.5	
SAMPLE #027									29.6	
									See "MURIWATR" for more detail	

				29-Oct-86		30-Dec-86	
	Jul-86	Aug-86	Sep-86	Oct-86	Nov-86	Dec-86	Jan-87
WEST END				21.2		19.4	
EAST END				4.3		3.4	

	26-Feb-87		16-Apr-87	27-May-87	23-Jun-87	20-Jul-87
	Feb-87	Mar-87	Apr-87	May-87	Jun-87	Jul-87
WEST END	14.5		12.7	20.5	25.5	10.8
EAST END	15.5		17.5	16.2	25.5	28.0

TREES

Growth:

2/15/87

TREE	ROW	AVE. HT.	AVE. DBH
Casuarina			
	1	8.4′	1.2"
	2	9.1′	1.3"
Eucalyptus (Lake Albacutya)			
	1	9.6′	1.4"
	2	9.0′	1.4"
	3	9.6′	1.5"
	4	9.9′	1.5"
	5	9.5′	1.5"
overall averages		9.5′	1.5"

(rows of trees measured from north to south)

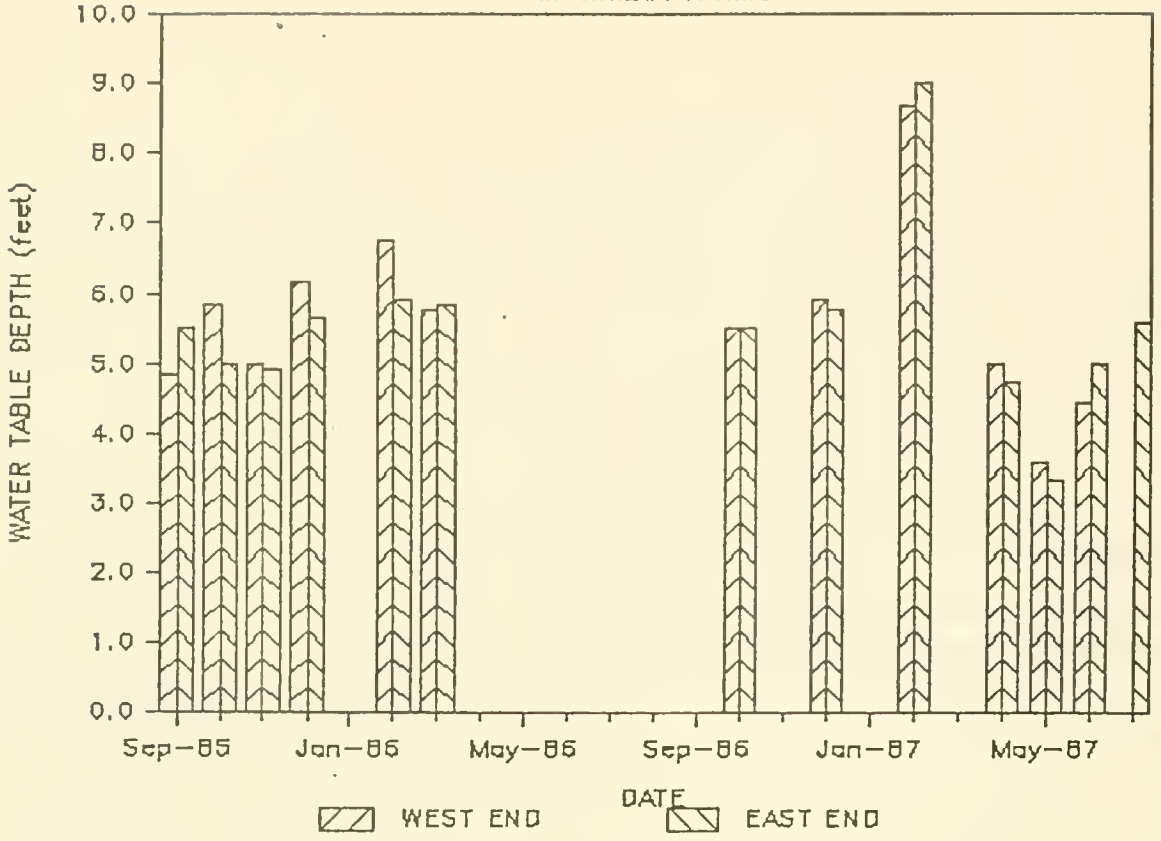
in 7/87, growth was estimated to be - 1/2 rate expected in soils w/o salt problems

	Mo./Yr.	3/87
Lab Analysis:		
wood		-
leaves		-

WEEDS	Mo./Yr.	9/86	3/87
		Fusilade applied in July & August, see file for detail map	no problem hand weeded

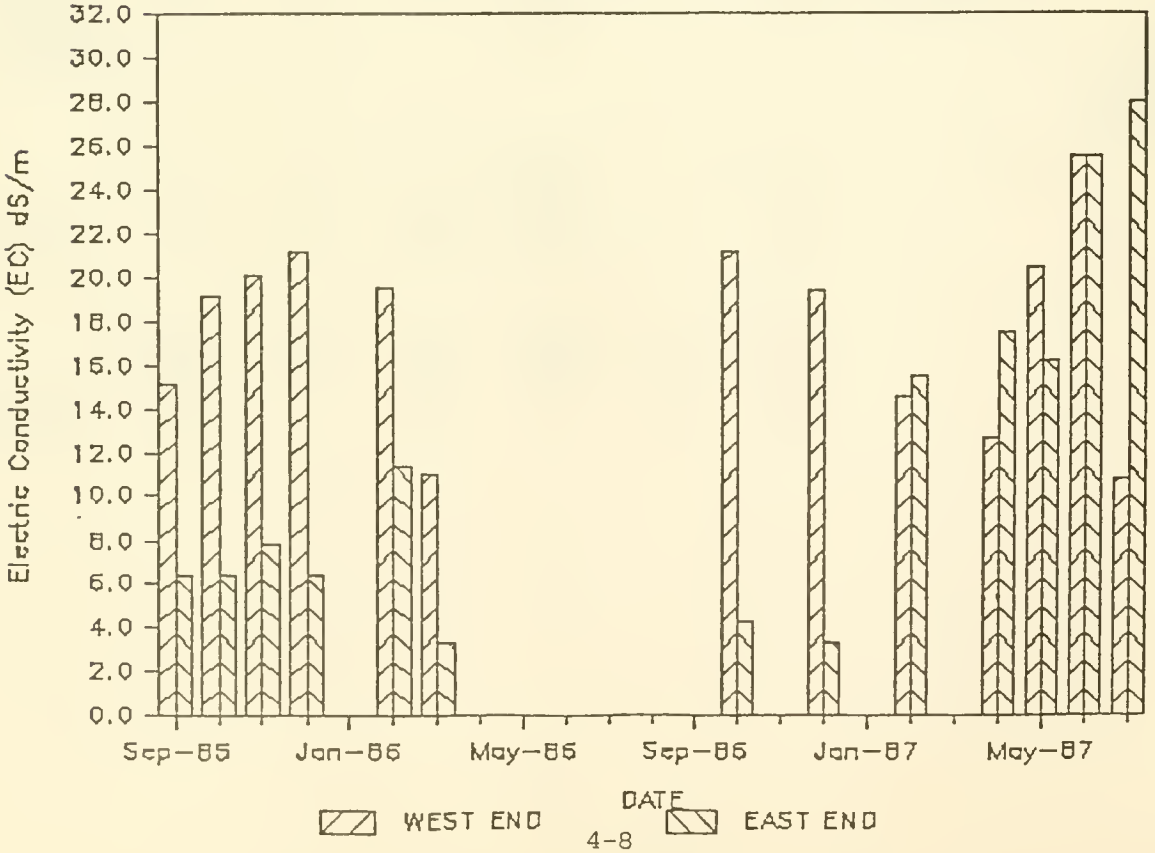
WATER TABLE DEPTH

MURRIETA FARMS



EC OF GROUND WATER

MURRIETA FARMS



MURRIETA FARMS disc: AGROFORESTRY II file: MURIWATR

last update: 9/18/87

WATER DATA

DATE	SAMPLE #	EC x 1000	Na (units?)	SAR	SATURATED PASTE (units?)	Ca (units?)	Mg (units?)	K (units?)	Cl (units?)	SO4 (units?)	NO3 (units?)	TOTAL SALTS (units?)
May 1986	026	22.5	343.9	56	2.3	35.3	40.8	0.2	238.9	174.1	12.4	1.1
	027	29.6	194.5	39	2.9	30.8	19.4	0.3	90.8	154.4		1.6

Depth (feet):

	23-Sep-85	09-Oct-85	21-Nov-85	19-Dec-85		10-Feb-86	24-Mar-86	
	Sep-85	Oct-85	Nov-85	Dec-85	Jan-86	Feb-86	Mar-86	Apr-86
WEST END	4.83	5.83	5.00	6.17		6.75	5.75	
EAST END	5.50	5.00	4.92	5.67		5.92	5.83	

						29-Oct-86		30-Dec-86
	May-86	Jun-86	Jul-86	Aug-86	Sep-86	Oct-86	Nov-86	Dec-86
WEST END						5.50		5.92
EAST END						5.50		5.75

	Jan-87	26-Feb-87		16-Apr-87	27-May-87	23-Jun-87	20-Jul-87
		Feb-87	Mar-87	Apr-87	May-87	Jun-87	Jul-87
WEST END		8.67		5.00	3.58	4.42	5.33
EAST END		9.00		4.75	3.33	5.00	5.58

7/87 letter states that water table in area has lowered due to drains being blocked (court order), water table varies according to irrigation of nearby lands where drain blocked

Electric Conductivity (Ec) of Ground water

	23-Sep-85	09-Oct-85	21-Nov-85	19-Dec-85		10-Feb-86	24-Mar-86		
	Sep-85	Oct-85	Nov-85	Dec-85	Jan-86	Feb-86	Mar-86	Apr-86	May-86
WEST END	15.2	19.2	20.1	21.1		19.5	11.0		
EAST END	6.4	6.4	7.8	6.4		11.3	3.3		
SAMPLE #026									22.5
SAMPLE #027									29.6

See "MURIWATR" for more detail

					29-Oct-86		30-Dec-86	
	Jun-86	Jul-86	Aug-86	Sep-86	Oct-86	Nov-86	Dec-86	Jan-87
WEST END					21.2		19.4	
EAST END					4.3		3.4	

	26-Feb-87		16-Apr-87	27-May-87	23-Jun-87	20-Jul-87
	Feb-87	Mar-87	Apr-87	May-87	Jun-87	Jul-87
WEST END	14.5		12.7	20.5	25.5	10.8
EAST END	15.5		17.5	16.2	25.5	28.0

MURRIETA FARMS

disc: AGROFORESTRY II file: MURISOIL
last update 9/8/87

SOIL DATA

Chemical Analysis
Trace Elements-Inductively Coupled Plasma Spectrophotometry
before planting (1985?)

SAMPLE #	Al ug/ml	As ug/ml	B ug/ml	Cd ug/ml	Cr ug/ml	Cu ug/ml	Fe ug/ml
87P470	0.2	0	24.5	0	0	0.2	0.4
87P471	0.6	0	10.1	0	0	0.1	0.9

	Hg ug/ml	Mn ug/ml	Mo ug/ml	Pb ug/ml	Se ug/ml	Si ug/ml	Zn ug/ml
87P470	0	0.1	0.1	0	0.8	11.4	0.5
87P471	0	0.1	0.1	0	0.2	12.8	0.1

DATE: MAY 1986
Units not shown
Soil samples from before planting
Summary of USDA-SCS report

SAMPLE # DEPTH (inches)	15 BAR	Ca	Mg	Na	K	Cl	SO4	NO3	TOTAL SALTS	EC
#001										
0 - 5.91	21.3	3.6	1.1	20.8	0.2	8.7	16.4		0.2	2.55
5.91 - 15.76	21.1	17.7	4.6	79.2	0.4	8.5	93.6		0.9	8.66
15.76 - 30.73	22.3	22.7	4.6	103.3	0.8	16.4	115.2		1.1	10.73
30.73 - 48.07	20.9	22.5	4.2	105.1	0.2	16.8	115.7		1.1	10.86
48.07 - 65.01	20.2	23.3	5.4	124.4	0.2	27.5	126.1		1	12.55
#002										
0 - 5.91	18.9	8.8	1	14.7	0.2	8.7	11.9		0.1	1.94
5.91 - 23.64	21.4	20.3	4.7	85.3	0.4	13.7	25.6		0.9	9.15
23.64 - 47.28	21.7	21.5	4.3	102.1	0.3	18.4	110.3		1.2	10.44
#003										
0 - 5.91	19.9	9	2.5	25.1	0.3	4.3	29.2		0.2	3.46
5.91 - 23.64	21.1	20.8	5	71.1	0.4	7.1	88.1	0.4	0.7	7.96
23.64 - 47.28	20.4	5	1.6	21.8	0.2	3.8	19.4		0.1	2.78
#004										
0 - 5.91	19.4	21.4	4.3	106	0.3	13.4	120		1	10.74
5.91 - 23.64	20.9	20.4	5	69	0.4	6.5	86.9		0.8	7.79
23.64 - 47.28	20.1	17.4	4	87.9	0.3	12.7	96.8		0.8	9.28
#005										
0 - 5.91	20.2	4.7	1.5	23.9	0.3	4.1	20.1		0.2	2.27
5.91 - 23.64	21.5	14.3	3.4	64.7	0.3	8.1	74.8		0.9	7.23
23.64 - 47.28	22.3	21.3	4.2	93	0.2	14.9	103.8		1.2	9.78

MURISOIL (page 2)

SAMPLE # DEPTH (inches)	15 BAR	Ca	Mg	Na	K	Cl	SO4	NO3	TOTAL SALTS	EC
#006										
0 - 5.91	18.1	4.9	1.2	10.7	0.2	1.2	12		0.1	1.66
5.91 - 23.64	21	22.4	6	61.5	0.4	3.7	85.5		0.5	7.33
23.64 - 47.28	21.8	20.5	5.3	81.7	0.4	7.8	116.7		0.9	9.68
#007										
0 - 5.91	21.3	1.3	0.5	14.1	0.2	4.2	4.9		0.1	1.63
5.91 - 23.64	20.9	21.8	5.6	86.7	0.4	14.5	99.5		0.9	9.42
23.64 - 47.28	21.1	21.9	4.9	107.8	0.3	24.2	112.6		1.1	11.1
#008										
0 - 5.91	21.5	1.6	0.5	10.4	0.2	2	2.4		0.1	1.25
5.91 - 23.64	20.6	9.3	2.9	55.5	0.2	5.7	60.8		0.6	6.26
23.64 - 47.28	21.6	4.3	5.2	102.7	0.2	14.2	111.4	0.8	1.1	10.64
#009										
0 - 5.91	19.7	3.0	0.8	9.4	0.2	1.0	10.4		0.1	1.39
5.91 - 23.64	20.0	17.7	4.7	45.3	0.4	2.4	63.2	0.4	0.4	5.77
23.64 - 47.28	23.2	21.0	5.1	83.8	0.3	7.8	105.3	0.8	1.0	9.23
#010										
0 - 5.91	20.4	11.9	3.3	18.2	0.4	2.2	29	0.3	0.2	3.08
5.91 - 23.64	22.1	5.8	2.1	36.2	0.2	4	38.7	1.6	0.4	4.87
23.64 - 47.28	21.8	21.8	6.1	93.6	0.2	9.4	111	0.9	0.9	9.9
#011										
0 - 5.91	19.8	3.3	0.8	8.9	0.2	2	8.8		0.1	1.35
5.91 - 23.64	1	19.4	5.2	81.4	0.4	8.2	93.1		0.8	3.84
23.64 - 47.28	21.2	20.3	4.4	109.8	0.3	12.2	122.7		1	11.11

DATE	SAMPLE #	DEPTH inches	EC X 1000	CATIONS meq/l	ALIQUOT	VERSINATE mls	Ca+Mg meq/l	Na meq/l	SAR	ESP
4-8-86	MB0	0	3.0	33	2	1.2	12	21	9	11
	MB1	12	3.6	40	2	0.4	4	36	25	25
	MB2	24	9.6	118	2	3.0	30	88	23	24
	MB3	36	12.8	160	2	3.1	31	129	33	33
4-8-86	MA0	0	2.2	23	2	0.8	8	15	7.5	9
	MA1	12	8.2	98	2	3.2	32	66	16.5	17
	MA2	24	13.3	165	2	2.9	29	136	36	34
	MA3	36	14.8	188	2	3.2	32	156	39	36

4.2 Peck Ranch

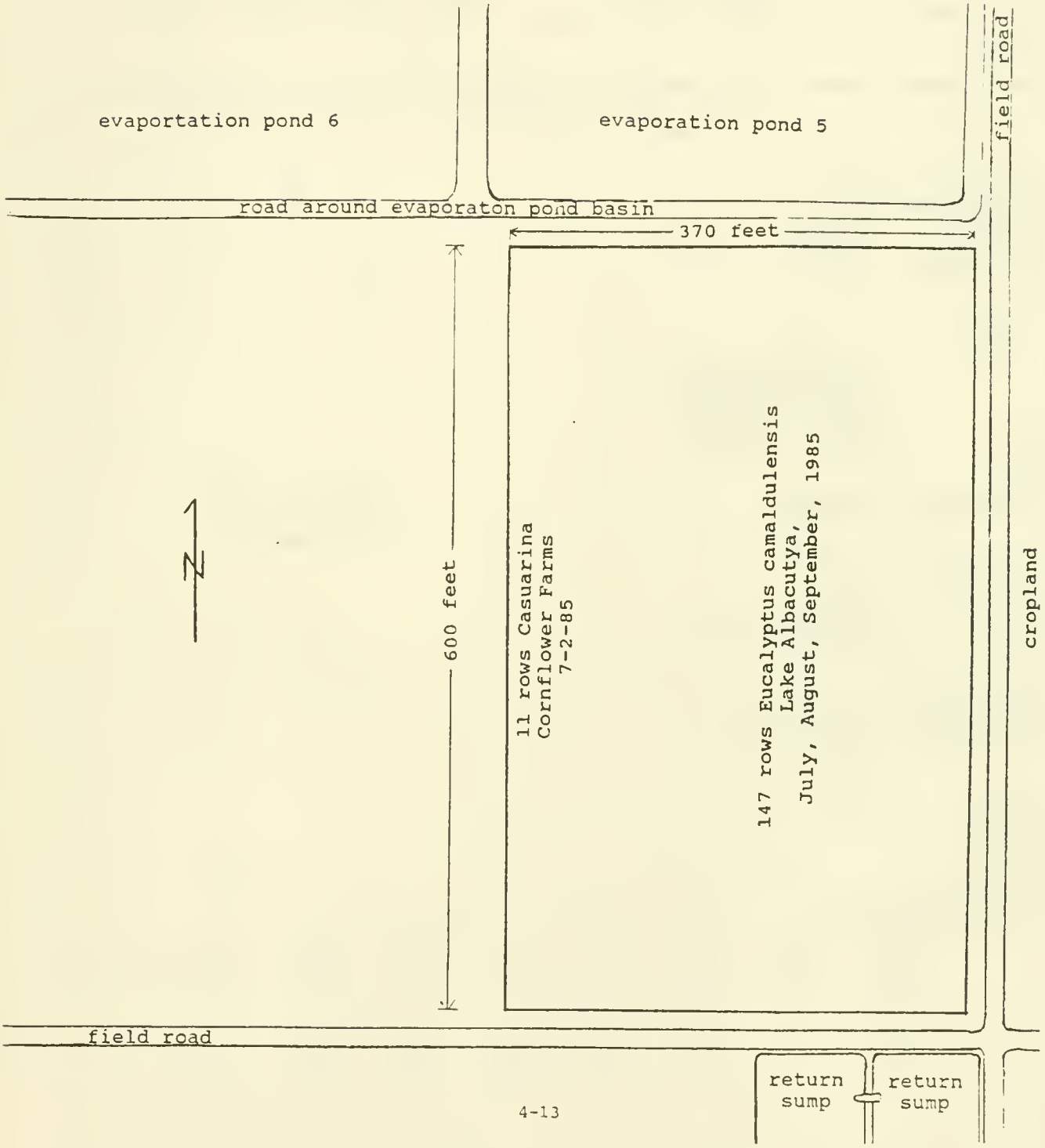
While Murrieta Farms exemplifies the intensively cared for plantation, Peck Ranch is an example of a neglected agroforestry planting. Although this farm site was well planned at the time of planting in 1985, due to a change of management it now receives little maintenance. Yet a surprising number of trees have survived heavy weed competition, damage from cotton defoliants, irrigation with saline water of up to 18,000 ppm TDS during the first year, and other hardships. This helps show the hardiness of the trees and the lack of upkeep they can tolerate.

The 8+ acre Peck plantation of eucalyptus and casuarina is located adjacent to 160 acres of evaporation ponds. The original plan was to allow the trees to establish with fresh irrigation water during the first year, and then to utilize the water from the adjacent pond. But the seedlings were accidentally irrigated with pond water during the first year. Defoliant, which drifted from nearby cotton fields, caused severe leaf damage in the fall of 1985. With no weed control implemented, many weeds took over the field, including morning glory, sunflower, lambsquarter, ragweed, and cocklebur. The heavy competition, with some plants overtopping or crawling up the branches of the trees, appears to have reduced tree growth. Yet, despite the lack of care this plantation has received, the trees stand at a density of around 50% of the original plantings. Surviving trees had reached the average heights of 7′ 8" and 5′ 6" for casuarina and eucalyptus, respectively, in March of 1987.

Although care of the farm has been neglected, the USDA-SCS in Fresno has continued to monitor the water table depth and electric conductivity as well as run several detailed soil and water analyses. These can be found in the following farm report. Students from CSUF - CIT began monthly monitoring of the water table in August 1987.

Trees from the Peck field trial have also been cut for the selection and propagation trials at UCD which are further discussed in Section 5.0. This farm is also part of the wildlife study.

PECK RANCH AGROFORESTRY DEMONSTRATION PLANTINGS



AGROFORESTRY - TREE PLANTING disc: AGROFORESTRY file: AGFOPECK
last update: 9/4/87

county: FRESNO

farm: PECK acreage: 8.2 av.tr/ac: 1052

PLANTING

DATE	NURSERY	SOURCE	EUCA-CAM	EUCA-oth	CAS-GLA	CAS-CUN	CAS-oth	POPLAR	MESQUIT	gr.tot.
		total:	7700	0	0	75	0	0	0	7775
7/2/85	CORNFL	ITCI					855			
7/22/85	planted 400	Euc, no more info								
8/19/85	SJN	L.ALBACUT	6000							
9/9/85	SJN	L.ALBACUT	1700							
3/4/86	CORNFL	CHAPMAN				75				

Comments

Mo./Yr	3/87
	lots of weed competition approx. stand density of 50%, cotton defoliant damage in fall 1985

SOILS

Lab Analysis:	see PECKSOIL
Mo./Yr.	3/87
Amendments:	none
Fertilizer:	none except w/ irrig. return water

IRRIGATION WATER

Quarter	3/87
Lab Analysis:	1/2 water from evap. ponds
Amount & Frequency:	2 acft for past year

WATER TABLE

Water Table Depth (feet):

23-Sep-85	03-Oct-85	21-Nov-85	19-Dec-85		10-Feb-86	24-Mar-86			
Sep-85	Oct-85	Nov-85	Dec-85	Jan-86	Feb-86	Mar-86	Apr-86	May-86	Jun-86
2.08	1.83	1.83	2.75		3.58	2.33			

29-Oct-86	30-Dec-86	26-Feb-87	14-Apr-87	27-May-87	23-Jun-87	20-Jul-87
Oct-86	Dec-86	Feb-87	Apr-87	May-87	Jun-87	Jul-87
3.67	3	2	3.42	3.33	6.25	6.33

Lab Analysis:

Electric Conductivity (Ec) of Water Table

23-Sep-85	03-Oct-85	21-Nov-85	19-Dec-85		10-Feb-86	24-Mar-86			
Sep-85	Oct-85	Nov-85	Dec-85	Jan-86	Feb-86	Mar-86	Apr-86	May-86	Jun-86
6.4	5.8	6.7	6.4		4.2	4.2			

29-Oct-86	30-Dec-86	26-Feb-87	14-Apr-87	27-May-87	23-Jun-87	20-Jul-87
Oct-86	Dec-86	Feb-87	Apr-87	May-87	Jun-87	Jul-87
4.5	4.2	7.8	7.8	8.4	7.70	7.21

TREES

Growth: Quarter 3/87

Tree	AVE. HT.	AVE. DBH
casuarina	7'8"	1.0"
eucalyptus	5'6"	0.9"

Lab Analysis:

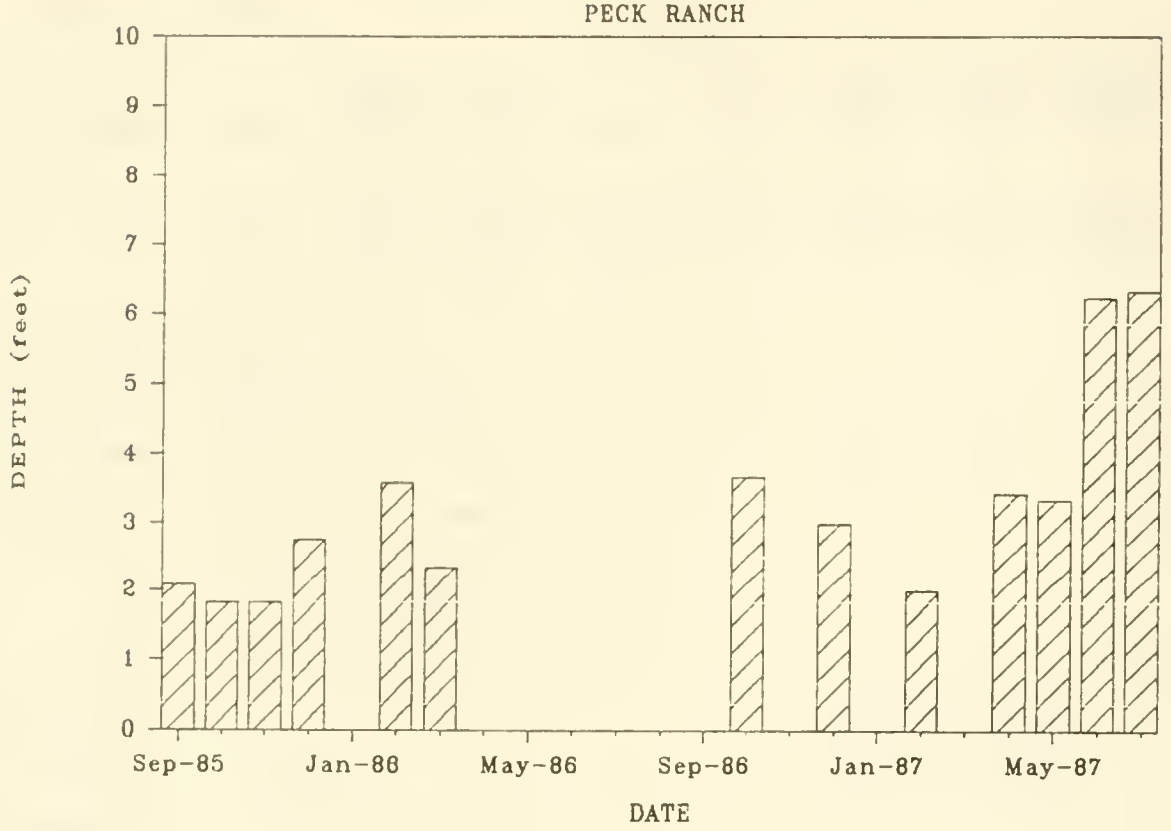
wood	-
leaves	-

WEEDS Quarter 3/87

heave comp., morning glory, sunflower, lambs-quarter, ragweed,cockle-bur. Reduced tree growth

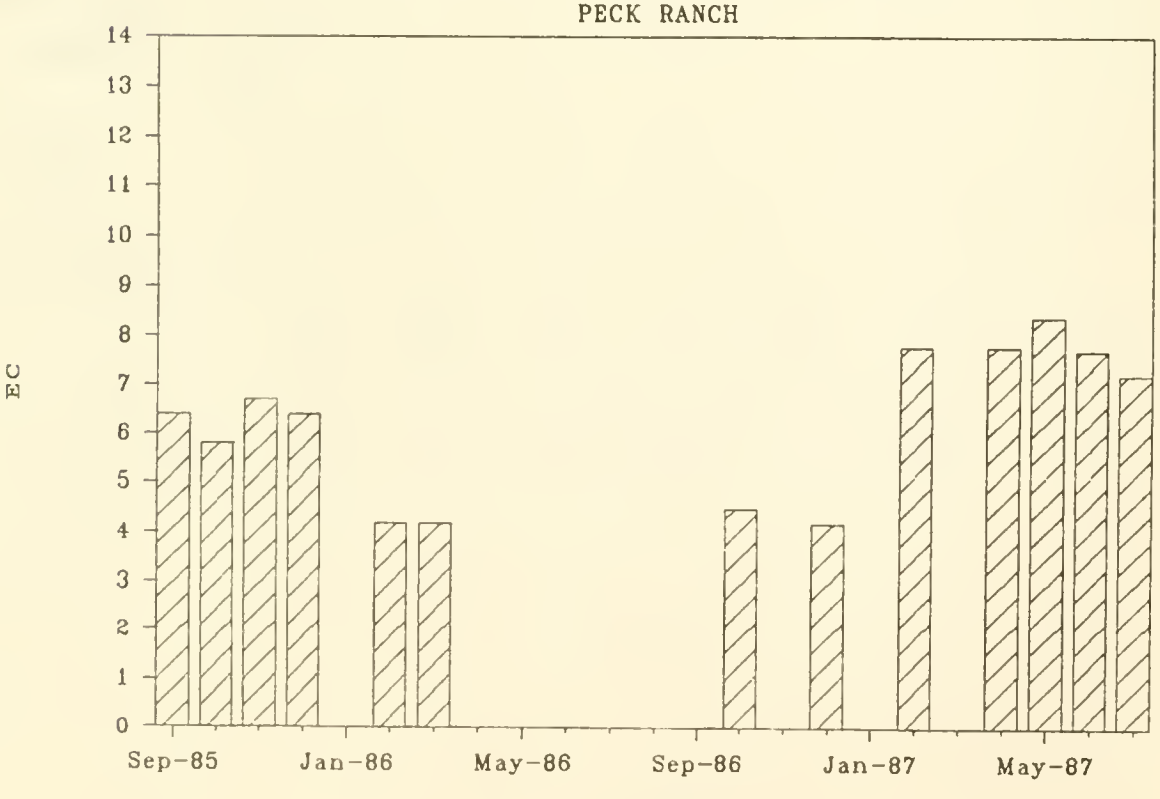
WATER TABLE DEPTH

PECK RANCH



EC OF GROUND WATER

PECK RANCH



PECK RANCH

disk: AGROFORESTRY DATA II file: PECKSOIL
last update: 9/4/87

SOIL DATA

Before Planting
Inductively Coupled Plasma Spectrophotometry
micrograms/milliliter

SAMPLE NUMBER	Al	As	B	Cd	Cr	Cu	Fe	Hg	Mn	Mo
87P472	1.0	0.0	1.5	0.0	0.0	0.1	1.4	0.0	0.1	0.0

SAMPLE NUMBER	Pb	Se	Si	Zn
	0.0	0.0	17.7	0.1

1/24/86

SAMPLE NUMBER	DEPTH inches	TEXTURE	DEFICIT MOISTURE	ESP	ECe
PA0	0	C	0.8	4.5	6.2
PA1	12	C	0.2	1.5	5.0
PA2	24	C	0.2	1.5	3.7
PA3	36	C	0.2	1.5	3.8
PB0	0				6.7
PB1	12				4.7
PB2	24				3.5
PB3	36				3.7

4/8/86	DEPTH inches	ESP	EC X 1000	CATIONS meq/l	ALIQUOT mls	VERSINATE mls	Ca+Mg meq/l	Na meq/l	SAR
PA0	0	4.5	6.2	72	2	5.2	52	20	4
PA1	12	1.5	5.0	56	2	4.5	45	11	2
PA2	24	1.5	3.7	41	2	3.4	34	7	2
PA3	36	1.5	3.8	43	2	3.5	35	8	2
PB1	0	3	6.7	79	2	6.1	61	18	3
PB2	12	4.5	4.7	53	2	3.7	37	16	4
PB3	24	1.5	3.5	38	2	3.0	30	8	2
	36	0.5	3.7	41	2	3.8	38	3	0.5

NOTE: 4/8/86 results appear the same as in 1/24/86, thus second date may be incorrect

Rough data is with Murrietta file

MAY, 1986 REPORT

DEPTH inches	15 BAR pct of <2mm	Ca MEQ/L	Mg MEQ/L	Na MEQ/L	K MEQ/L	Cl MEQ/L	SO4 MEQ/L	NO3 MEQ/L	TOTAL SALTS pct	EC mmhos/cm
#013										
0-5.91	18.4	32.5	6.9	9	0.7	11.5	35	2.2	0.2	4.17
5.91-23.64	21.4	30	6.6	12.6	0.4	10.8	35	2.2	0.2	4.03
23.64-47.28	20.8	23.2	4.1	22.5	0.2	7.2	39.3	0.3	0.2	1.71
#014										
0-5.91	18.4	19.2	4.6	6.1	0.5	3.8	18.9	5.3	0.1	2.61
5.91-23.64	19.9	16.3	4.4	5.8	0.3	4.2	17.1	3.8	0.1	2.35
23.64-47.28	19.5	27.3	6	12.5	0.3	5.2	39.9	1.4	0.2	3.65

PECKSOIL (continued)

DEPTH inches	15 BAR pct of <2mm	Ca MEQ/L	Mg MEQ/L	Na MEQ/L	K MEQ/L	Cl MEQ/L	SO4 MEQ/L	NO3 MEQ/L	SALTS pct	EC mmhos/cm
#015										
0-5.91	19.8	18.6	3.7	6.9	0.6	4.1	12	10.1	0.1	2.65
5.91-23.64	21.9	14.2	3	7.9	0.3	4.2	16	3.3	0.1	2.29
23.64-47.28	19.5	27.4	4.6	19.5	0.3	5.8	41.6	unclear	0.2	3.99
#016										
0-5.91	20.5	42.7	9.2	20.9	0.8	18.9	32.4	18.1	0.4	6.04
5.91-23.64	22.3	29.5	6.7	14.5	0.4	11.1	30.3	5.6	0.3	4.13
23.64-47.28	21.3	25.7	3.9	16.9	0.2	2.8	39.3	1.2	0.2	3.54
#017										
0-5.91	18.6	29.3	6.7	14.1	0.7	8.6	34.1	3.9	0.2	3.89
5.91-23.64	21.2	30.3	7.6	15.4	0.3	10.5	35.3	3.8	0.3	4.25
23.64-47.28	21.8	28.1	5.1	14.4	0.2	5	38.9	2.6	0.2	3.61
#018										
0-5.91	21.3	34.2	7.8	12.7	0.7	12.1	28.8	10.4	0.3	4.5
5.91-23.64	23.4	29	6.6	10.9	0.5	8.6	30.7	4.2	0.2	3.73
23.64-47.28	23.7	27.6	4.9	9.9	0.4	5.2	32.3	2.6	0.2	3.29
#019										
0-5.91	21.7	27.9	5.7	31.7	0.6	10.7	45.1	6.3	0.3	5.33
5.91-23.64	22.2	28.3	5.5	20.5	0.5	8.8	39.7	3.3	0.3	4.33
23.64-47.28	24.2	27	4.8	23.6	0.3	6.4	46.7	1.6	0.3	4.36
#020										
0-5.91	24.2	38.1	8.7	20.6	0.8	23.2	33.2	9.1	0.3	5.52
5.91-23.64	24.5	22.1	5.1	11.3	0.5	8.3	26.1	1	0.2	3.14
23.64-47.28	23.7	29.4	5.7	16.5	0.3	9.9	39	---	0.3	3.99
#021										
0-5.91	23.4	8.2	2	5.4	0.4	1.6	10.6	---	0.1	1.43
5.91-23.64	22.7	5.4	1.5	4.7	0.2	1.5	7.8	---	0.1	1.21
23.64-47.28	21.2	17.4	3.3	17	0.3	3	35.6	---	0.2	3.21
#022										
0-5.91	21.6	34.5	7.9	10.9	0.9	16	27	12.2	0.3	4.67
5.91-23.64	25.3	31.1	7.1	9.8	0.6	12.5	30.1	5.3	0.2	3.83
23.64-47.28	23.2	14.4	2.9	8.5	0.3	4	21.2	0.8	0.1	2.38
#023										
0-5.91	16.8	2.7	0.6	4.4	0.4	2.5	1.7	1.3	TR	0.89
5.91-23.64	16.6	37.9	6.2	6.3	0.4	43.3	37.1	24.5	0.5	9.74
23.64-47.28	22	25.5	4.1	118.1	0.4	36.8	96	18.4	0.9	12.57
#024										
0-5.91	14.2	26.5	7.8	8.9	1.1	1.1	39.5	---	0.1	3.29
5.91-23.64	15.8	25.3	5.2	41.5	0.7	13.6	44.5	12.2	0.3	6.37
23.64-47.28	21.2	21.5	3.5	111.2	0.3	29.6	94.8	14.4	0.7	11.94

4.3 Thomsen Brothers

The Thomsen Brothers farm was planted with 8,700 Eucalyptus camaldulensis (Lake Albacutya seed source) and 475 Casuarina cunninghamiana in May of 1986. Three additional acres of Eucalyptus camaldulensis (Lake Albacutya) were planted in June of 1987. October 1987 plantings include 3 acres of E. camaldulensis, planted in a high water table area which was previously drained into the San Luis Drain (and to Kesterson Reservoir), and a 2 acre extension of the first planting of 1986. The rows of trees on this plantation run nearly 1/2 mile in length and should help reduce soil erosion in adjacent fields by providing a windbreak. The trees have been staked to prevent the trunks from bending due to the strong winds in the area. Young casuarina have been found to be more resistant to wind stress than the young eucalyptus, possibly because of their slender, needle-like leaves which allow the wind to pass.

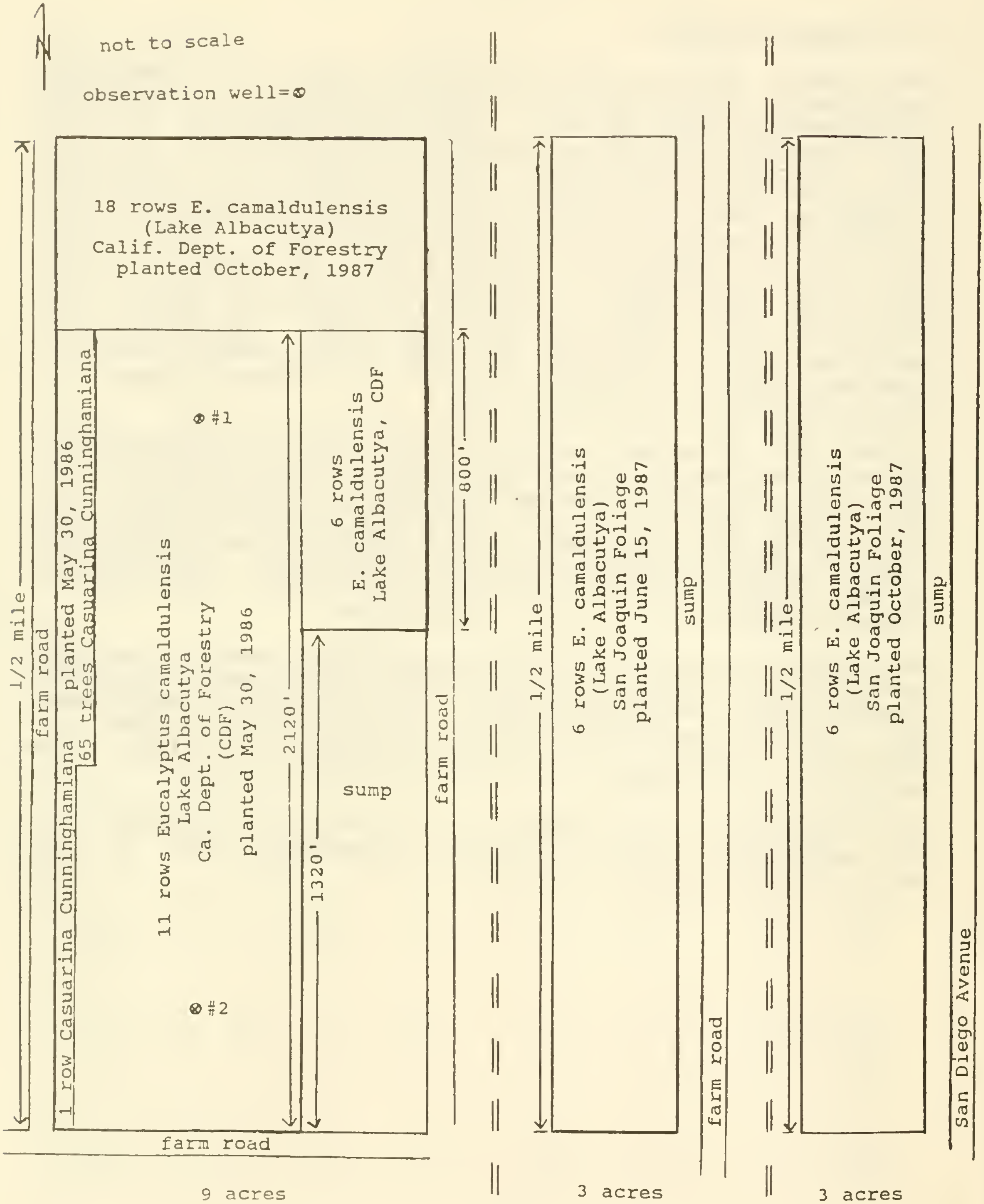
The trees on the Thomsen Brothers farm appear to be growing quite well and some trees are reaching heights of 14 to 16 feet in one year. The seedlings received good quality Westlands water last year and are using ground water supplemented with drainage water from the adjacent sump this year. Weeds have been adequately controlled both with chemical sprays and by hand. No fertilizer or soil amendments have been added. Some trees appear to be slightly damaged by the drift of herbicides.

The USDA-SCS in Fresno took bimonthly and later monthly measurements of water table depth and EC until last August, when CSUF students began biweekly monitoring. Soil and water samples have been (and in the future will be) sent to Dellavalle Labs for analysis. The results of the first analyses are included with the following farm report.

This farm is also under observation as part of the wildlife study and outstanding trees will be utilized next year for the UCD selection and propagation project.

THOMSEN BROTHERS AGROFORESTRY DEMONSTRATION PLANTINGS

3 Locations



AGROFORESTAGROFORESTRY PLANTINGS disc: AGROFORESTRY file: AGFOTHOM

last update: 10/17/87

county: FRESNO

farm: THOMSEN acreage: 15 av.tr/ac: 1192

PLANTINGS

DATE	NURSERY	SOURCE	EUCA-CAM	EUCA-oth	CAS-GLA	CAS-CUN	CAS-oth	POPLAR	MESQUITE	gr.tot.
		total:	17400	0	0	475	0	0	0	17875
5/30,6?/86	CDF	L.ALBACUT	8700							
5/30,6?/86	CDF	AUSTRALIA				475				
6/15/87	SJF	L.ALBACUTYA	3000							
10/87	SJF	L.ALBACUTYA	4200	?#						
10/87	CDF	L.ALBACUTYA	1500							

	Mo./Yr.	3/87	9/87	10/87
Comments:		look very good, staked trees 1st planting 7 acres	Trees planted 6/15 in 6 rows, 1/2 mile long, 6.5'X5.5', 3 acres, next to sump, 1 mi. S and 1/2 mi. E of 1st planting	3 ac spaced 6.5X5' in hi water table area, had been tiled to SL drain, next to sump, 2 ac extends 1st planting to 1/2 mi, spacing 6.5'X 5.5' by San Diego Ave.

SOIL	Mo./Yr.	3/87	7/87
Lab Analysis:		-	see THOMSOIL

Amendments: none

Fertilizer: none

IRRIGATION WATER

	Mo./Yr.	3/87
Lab Analysis:		good quality Westlands 1st year, sump water this year

Amount & Frequency: total this past year = 1.5 ac ft

WATER TABLE

Depth (feeet):

	29-Oct-86		30-Dec-86		26-Feb-87		20-Apr-87	27-May-87	23-Jun-87	20-Jul-87
	Oct-86	Nov-86	Dec-86	Jan-87	Feb-87	Mar-87	Apr-87	May-87	Jun-87	Jul-87
NORTH END	5.67		6.5		5.83		4.33	4.00	5.33	7
SOUTH END	5.08		6.67		7.67		4.42	3.33	5.25	6.58

Lab Analysis:

Electric Conductivity (Ec) of ground water

	29-Oct-86				26-Feb-87		20-Apr-87	27-May-87	23-Jun-87	20-Jul-87
	Oct-86	Nov-86	Dec-86	Jan-87	Feb-87	Mar-87	Apr-87	May-87	Jun-87	Jul-87
NORTH END	6.5				6.9		7.5	7.8	8.08	7.52
SOUTH END	6.5				7.7		7.4	7.3	7.67	7.66

also see THOMWATR

TREES Mo./Yr. 3/87

Growth: -

Lab Analysis:

wood -

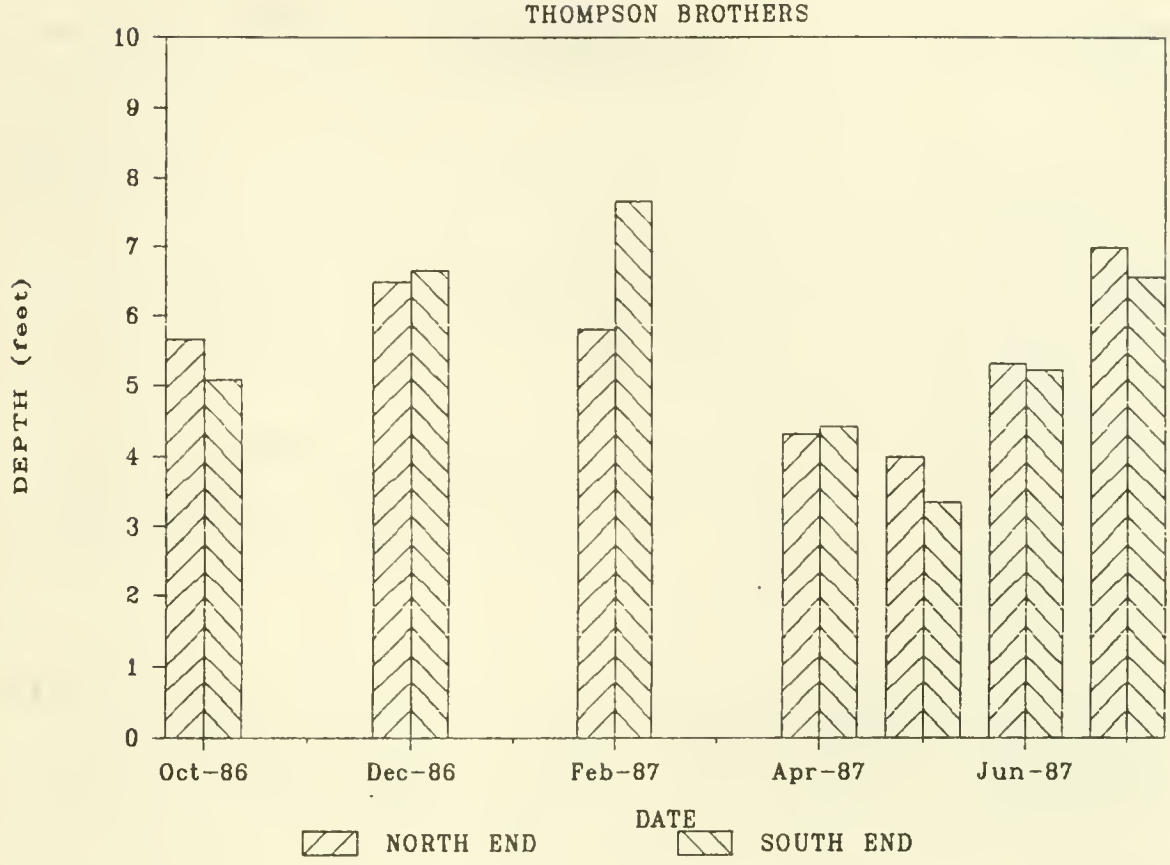
leaves -

WEEDS Mo./Yr. 3/87

chemical sprays & hand weeding adequate

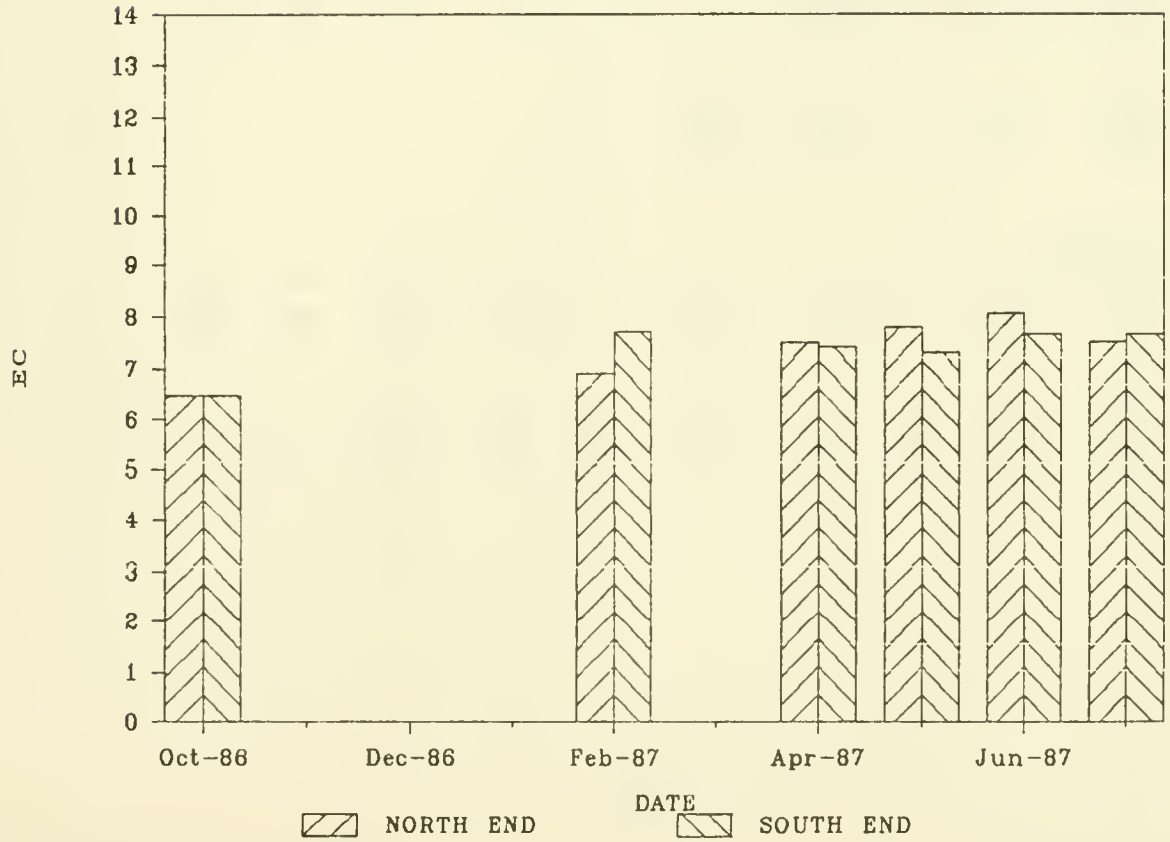
WATER TABLE DEPTH

THOMPSON BROTHERS



EC OF GROUND WATER

THOMPSON BROTHERS



Thompson Ranch

disc: AGROFORESTRY II file: THOMWATR
last update: 9/4/87

WATER DATA

DATE	SAMPLE	DEPTH feet	EC
10-29-86	North End	5.67	6.5
	South End	5.08	6.5
12-30-86	North End	6.5	
	South End	6.67	
2-26-87	North End	5.83	6.9
	South End	7.67	7.7
4-20-87	North End	4.33	7.5
	South End	4.42	7.4
5-27-87	North End	4.00	7.8
	South End	3.33	7.3
6-23-87	North End	5.33	8.08
	South End	5.25	7.67
7-20-87	North End	7	7.52
	South End	6.58	7.66

5/4/87
Dellavalle Labs
Undigested Sample

EC	Ca	Mg	Na	SAR	SAR	Cl	CO3+HCO3	SO4-S	B
dS/m	Meq/l	Meq/l	Meq/l		adj	Meq/l	Meq/l	mg/l	mg/l
7.16	32.7	22	46.0	8.8	27.1	15.4	8.7	1000	6.8

NO3-N	Fe	Mn	Li	F	pH
mg/l	mg/l	mg/l	mg/l	mg/l	
54.6	<0.1	<0.05	0.3	0.16	7.5

Digested Sample

P	K	Zn	Mn	Na	Fe	Cu	Ca	Mg	Be
mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
2.8	9.9	4.1	1.6	955	28.6	3.9	807	334	<0.025

V	Pb	Cr	Cd	As	Hg	Se	Mo	Al	Si
mg/l	mg/l	mg/l	mg/l	ug/l	ug/l	ug/l	mg/l	mg/l	mg/l
<0.8	0.3	0.27	<0.025	7	<0.2	32	0.4	16.5	29.0

THOMPSON RANCH

disc: AGROFORESTRY II file: THOMSOIL
last update: 9/4/87

SOIL DATA

Dellavalle Labs
5/5/87

Undigested											
SP	pHs	ECe	Ca	Mg	Na	Cl	ESP	B	NO3-N	PO4-P	K (AA)
		dS/m	Meq/l	Meq/l	Meq/l	Meq/l		mg/l	mg/kg	mg/kg	mg/kg
39	7.5	6.0	37	16	24	17.2	5.3	2.4	88	16	320

Undigested				
Zn	Mn	Fe	Cu	SO4-S
mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
0.7	9.1	9.4	1.1	310

DTPA Extract				Saturated Paste Extract						
Ni	Pb	Cr	Cd	Hg	As	Se	NO3-N	PO4-P	K	SO4-S
mg/kg	mg/kg	mg/kg	mg/kg	ug/l	ug/l	ug/l	mg/l	mg/l	mg/l	mg/l
1.4	0.6	<0.25	<0.05	<0.2	17	76	225	<0.1	68	710

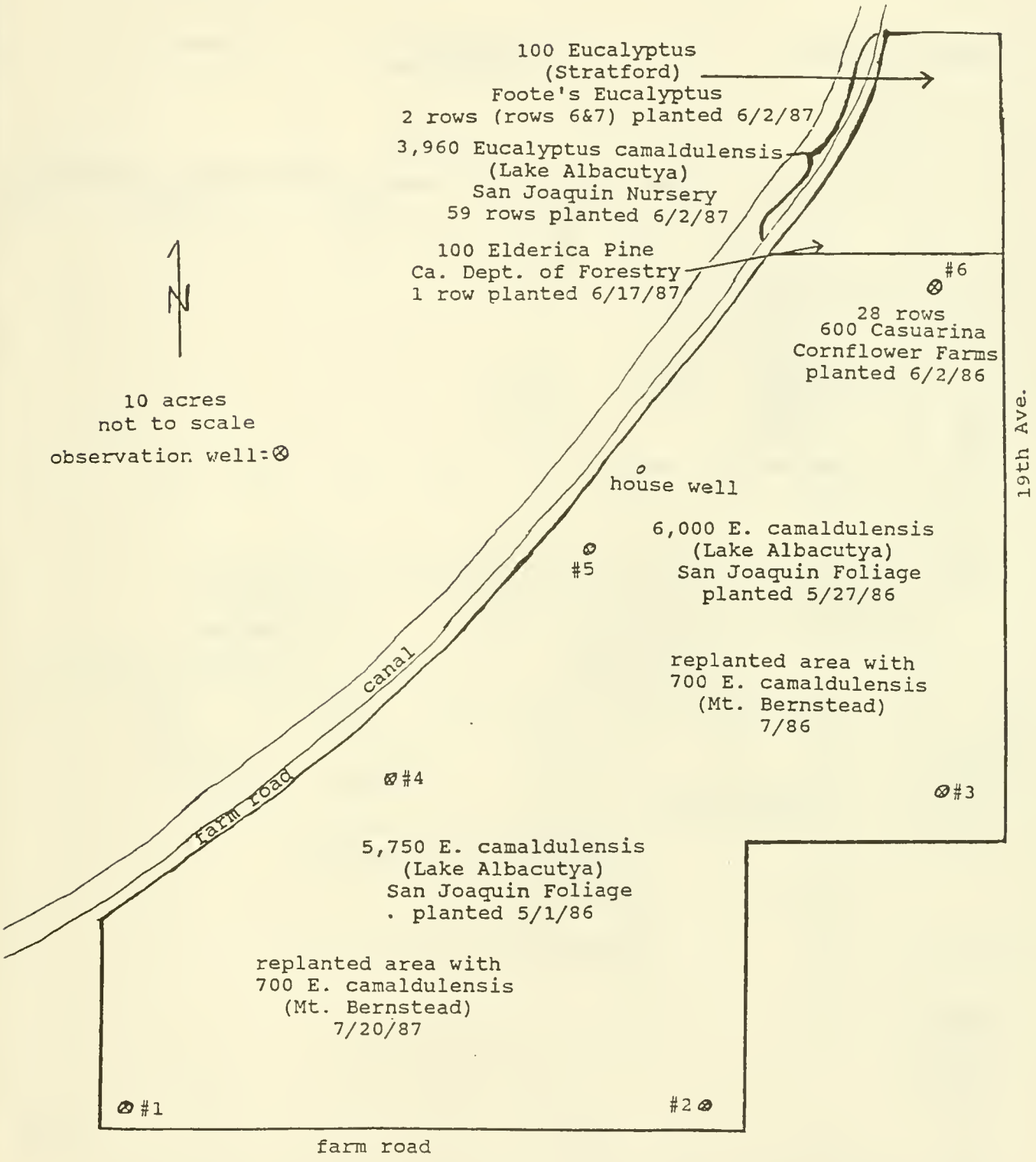
4.4 Carollo

Sal Carollo planted 7 acres of his farm with Eucalyptus camaldulensis (various seed sources) and various casuarina species in May and June of 1986. This year he added about 3 acres of eucalyptus and one row of Elderica pine (Pinus elderica). This plantation clearly shows the differences between planting on good and poor quality soil. The variation in growth characteristics is dramatically evident, with a sudden change from the area of lush growth to that with stunted trees. At 3 to 4 months of age (October 1986), the largest trees stood 6 to 7 feet tall, while seedlings planted in the highest sodium areas showed very little growth (7 to 12 inches tall) and poor color. Gypsum was applied to two rows of these trees, and the response was evident almost immediately, with the leaf yellowing gone in two weeks and the trees outgrowing the untreated, sodium affected plants in two months. Gypsum was later applied to the entire eucalyptus planting.

This plantation has also received 2 applications of fertilizer. Weeds have been kept under control with Round-up and Fusilade. The seedlings received good quality irrigation water for the first year. This year irrigation frequency has been reduced because the trees seem to be utilizing ground water. No weeding has been necessary this year for the 1986 plantings.

The USDA-SCS in Hanford has monitored the water table depth and EC and has run several analyses of soil and ground water. Samples have also been sent to Dellavalle Labs. These data are included in the following farm report. In 1988 cuttings from superior trees will be taken for the selection and propagation project.

SAL CAROLLO AGROFORESTRY DEMONSTRATION PLANTINGS



AGROFORESTRY - TREE PLANTING

disc: AGROFORESTRY

file: AGFOCARO

last update: 10/23/87

county: KINGS

farm: CAROLLO acreage: 10 av.tr/ac: 1641

DATE	NURSERY	SOURCE	EUCA-CAM	EUCA-oth	CAS-CUN	CAS-oth	POPLAR	MESQUITE	ELDER. PINE	gr.tot.
		total:	15710	100	0	600	0	0	100	16410
5/1/86	SJN	L.ALBACUT	5750							
5/?/86	SJN(replant)	MT BERNSTEAD	(700)							
	*	1 row Alice Springs								
5/27/86	SJN	L.ALBACUT	6000							
6/2/86	CORNFL	AUSTRALIA				600				
86	CDF(replant)	L.ALBACUTYA	(2000)							
6/2/87	SJN	L.ALBACUTYA	3960							
6/2/87	Foote	STRATFORD		100						
6/2/87	CDF	Elderica Pine							100	
7/20/87	SJF(replant)	MT BERNSTEAD	(700)							

* unclear info

Comments:	begin 86	end 86	3/87	9/87
Mo./Yr.	irrig. 2 days after planting, lost 10%. 2nd planting in moist soil, <4% loss	Alice Spr. & Mt Bern. doing better than (Albacut.), but larger leaves may catch wind, defoliant damage South side, phos. gyp. plot better color & growth	doing well except in Na effected soils, Cas all growing well	New plantings on 3 ac, 5.5'X 6', replant 30% need to check info on replants, death prob. due to hi SAR, hi Na

SOILS

Mo./Yr.	86	3/87	5/87	7/87
Lab Analysis:	with Na, no Ca+Mg, Ec 4.0 mmhos/cm, 2560 ppm	see CAROSOIL	see CAROSOIL	see CAROSOIL
Amendments:		gypsum around trees in 2 rows, leaf yellowing gone in 2 weeks, out-growing others in 2 months	20 T 90% gypsum on Eucalyptus only (5 tons/ac in 2/87)	
Fertilizer:		2 applications, 15 un. N and 17 units N (50 & 70?)	none this quarter	

IRRIGATION WATER

Lab Analysis:

Date	Ec X 1000	ppm TDS	amount (ac. ft.)
25-Mar-87	0.04	25	1.2
29-Apr-87	0.04	25	1

Mo./Yr.	86	3/87	5/87
Amount & Frequency:	5/14,5/28,6/15,7/14, 7/27,8/1,8/19,9/11, 9/30. Total 9 Xs, ave. 1 acft/irrig. (7 ac)	-	see above

WATER TABLES

Water Table Depths (feet)(3/86 - 10/86 from carowatr):

WELL #	13-Mar-86		12-May-86		21-Jul-86		26-Sep-86	13-Oct-86		
	Mar-86	Apr-86	May-86	Jun-86	Jul-86	Aug-86	Sep-86	Oct-86	Nov-86	Dec-86
1	5		4.1		3.1		5.0	5.5		
2			4.1		3.5		4.4	5.8		
3			4.1		3.2		5.6	5.6		
4					2.8		5.0	5.3		
5					2.4		5.0	5		
6					2.3		4.8	4.8		
					3 days aft. irrigation canal running			7 days aft. irrigation canal dry		

WELL #						25-Jun-87		12-Aug-87
	Jan-87	Feb-87	Mar-87	Apr-87	May-87	Jun-87	Jul-87	Aug-87
1					4.5	3.6		3.1
2					5	4.0		3.8
3					4.5	3.6		3.7
4					4.5	3.5		3.0
5					4.2	2.8		2.5
6					4	2.8		2.5

Lab Analysis: also see CAROWATR

Electric Conductivity of Ground Water (Ec X 1000) (from carowatr)

WELL #	13-Mar-86		12-May-86		21-Jul-86		15-Sep-86	13-Oct-86		
	Mar-86	Apr-86	May-86	Jun-86	Jul-86	Aug-86	Sep-86	Oct-86	Nov-86	Dec-86
1	0.53		1.42		0.76			0.73		
2			0.52		0.97			0.21		
3			0.51		0.65			0.64		
4					0.64			0.63		
5					0.61			0.8		
6					0.23			0.66		

WELL #						25-Jun-87		12-Aug-87
	Jan-87	Feb-87	Mar-87	Apr-87	May-87	Jun-87	Jul-87	Aug-87
						0.6		0.5
1						0.5		0.4
2						0.5		0.4
3						0.5		0.6
4						1.6		1.1
5						0.2		0.3
6								

TREES

Growth:

Mo./Yr.	10/86	12/86	3/87	5/87
	largest trees 6'-7', in hi SAR & ESP areas 7"-12" tall	See CAROGROW	2.72 ft ave. growth 9% died (91% survival)	excellent in better soils, trees respond to gypsum

Lab Analysis:

Wood	-	-
Leaves	-	-

WEEDS	Quarter	3/87 satisfactory control Round-up on Johnson grass, some tree damage	5/87 Fusilade to Euc. & Cas. on 5-20-87

SAL CAROLLO

disc: AGROFORESTRY II file: CAROWATR
last update: 9/3/87

WATER DATA

DATE	SAMPLE #	DEPTH feet	pH	EC x 1000	CATIONS meq/l	ALIQUOT mls	VERSINATE mls	Ca + Mg meq/l	Na meq/l	SAR	ESP	REMARKS
3/31/86	1	5		.53	5.3	2	0.4	4.0	1.3	(18)	(20)	(?) data on records unclear
5/12/86	1	4.1		1.42	14.2	2	0.2	2.0	12.2	12.2	12.5	Perched water tables
	2	4.1		.52	5.2	2	0.2	2.0	3.2	3.2	3.6	Perched water tables
	3	4.1		.51	5.1	2	0.2	2.0	3.1	3.1	3.5	Perched water tables
7/21/86	1	3.1		.76	7.6		2.0					
	2	3.5		.97	9.7		3.0					
	3	3.2		.65	6.5		1.0					
	4	2.8		.64	6.4		2.0					
	5	2.4		.61	6.1		2.0					
	6	2.3		.23	2.3		1.0					
9/26/86	1	5.0										
	2	4.4										
	3	5.6										
	4	5.0										
	5	5.0										
	6	4.8										
10/13/86	1	5.5	8.1	.73	7.3			2.0	5.3	5.3	5.7	
	2	5.8	8.2	.21	2.1			1.0	1.1	1.5	1.7	
	3	5.6	8.6	.64	6.4			2.0	4.4	4.4	4.8	
	4	5.3	8.4	.63	6.3			2.0	4.3	4.3	4.7	
	5	5.0	8.1	.80	8.0			2.5	5.5	4.4	4.9	
	6	4.8	8.0	.66	6.6			2.2	4.4	4.1	4.3	
5/87	1	4.5										
	2	5										
	3	4.5										
	4	4.5										
	5	4.2										
	6	4										
6/25/87	1	3.6		0.6								
	2	4.0		0.5								
	3	3.6		0.5								
	4	3.5		0.5								
	5	2.8		1.6								
	6	2.8		0.2								

CAROWATR (continued)

DATE	WELL #	DEPTH feet	pH	EC x 1000	CATIONS meq/l	ALIQUOT mls	VERSINATE mls	Ca + Mg meq/l	Na meq/l	SAR	ESP	REMARKS
8-12-87	1	3.1		0.5								
	2	3.8		0.4								
	3	3.7		0.4								
	4	3.0		0.6								
	5	2.5		1.1								
	6	2.5		0.3								

5/4/87
Dellavalle Labs
Undigested Sample

EC	Ca	Mg	Na	SAR	SAR	Cl	CO3+HCO3	SO4-S	B	NO3-N
dS/m	Meq/l	Meq/l	Meq/l		adj	Meq/l	Meq/l	mg/l	mg/l	mg/l
0.52	2.1	2.2	1.5	1.0	2.2	0.2	4.9	4	0.2	0.8

Fe	Mn	Li	F	pH
mg/l	mg/l	mg/l	mg/l	
<0.1	<0.05	<0.04	1.7	7.5

Digested Sample

P	K	Zn	Mn	Na	Fe	Cu	Ca	Mg	Be	V
mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
0.2	0.9	0.1	0.07	34.9	1.3	0.1	25.9	26.1	<0.025	<0.8

Pb	Cr	Cd	As	Hg	Se	Mo	Al	Si
mg/l	mg/l	mg/l	ug/l	ug/l	ug/l	mg/l	mg/l	mg/l
<0.1	<0.25	<0.025	26	<0.2	<2	<0.1	1.0	31.3

SAL CAROLLO

disc: AGROFORESTRY II file: CAROSOIL
last update: 9/3/87

SOIL DATA

DATE	SAMPLE #	DEPTH inches	pH	EC x 1000	CATIONS meq/l	ALIQUOT mls	VERSINATE mls	Ca + Mg meq/l	Na meq/l	SAR	ESP	REMARKS
2/18/86	2	0 - 12		4.7	53	2	.3	3.0	50	41	38	
		3 - 18		3.2	35	2	.4	4.0	31	22	23	
	3A	6 - 24		6.8	80	2	1.0	10.0	70	31	31	
	3B	24 - 36		2.8	30	2	.4	4.0	26	(18)	(20)	(?) data on records unclesr
3/31/86	1	0 - 10		4.6	52		.2	2.0	50	50	52	
	2	10 - 20		2.10	22		.2	2.0	20	20	21	
	3	20 - 30		0.59	5.9		.2	5.7	57	34	36	
	4	30 - 40		0.76	7.6		.4	4.0	7.2	5.0	5.2	
	5	40 - 50		0.51	5.1		.2	2.2	4.9	4.67	5.05	
7/2/86		0 - 12		3.5	38		.1	1.0	37	52	53	Trees have died twice
7/21/86		0 - 12	8.6	7.5	85		.2	2.0	83	83	84	Before gyp
7/28/86	1	0 - 12	8.4	2.45	27		.2	2.0	25	25	26	Large tree 4' tall
	2	0 - 6	9.2	9.60	118		.1	1.0	117	167	169	Trees planted 2Xs & died
	3	6 - 12	9.5	9.30	113		.1	1.0	112	160	163	Trees planted 2Xs & died
10/13/86		0 - 12	9.0	6.7	80		.6	6.0	74	42	45	After gyp
10/13/86	1	0 - 12	9.1	1.56	15.6		.3	3.0	12.6	10	12	Large tree 7' tall
	2	0 - 12	8.9	2.1	22		2.2	22	0	0	0	Alice Springs 3' tall
	3	12 - 24	8.0	3.8	43		.3	3.0	40	32	33	Alice Springs 3' tall
	4	0 - 12	9.3	8.6	105		.1	1.0	104	147	150	No gyp, trees died twice
4/87	live trees	0 - 12	9.2	4.2	47		0.2	2.0	45	45		just staying alive
	dead trees	0 - 12	9.3	8.1	96		0.3	3.0	93	76		

DATE	SAMPLE #	DEPTH inches	pH	EC x 1000	CATIONS meq/l	ALIQUOT mls	VERSINATE mls	Ca + Mg meq/l	Na meq/l	SAR	ESP	REMARKS
6/22/87	E. side	0 - 12	8.8	5.6	64	2	0.5	5	59	38		1 yr old, avg 4' in 4/87
	W. side	0 - 12	8.3	1.1	11	2	0	<1	10.9	?50		
8/87	new plant.	0 - 12	8.4	6.5	78		0.6	6.0	72	41		New euc planting
		12 - 24	8.8	3.8	43		0.2	2.0	41	41		
		24 - 36	8.3	1.94	19		0.4	4.0	15	11		
		36 - 48	7.9	0.83	8.3		0.6	6.0	2.3	1		

CAROSOIL (continued)

Dellavalle Labs
5/5/87

Undigested										
SP	pHs	ECe	Ca	Mg	Na	Cl	ESP	B	NO3-N	PO4-P
		dS/m	Meq/l	Meq/l	Meq/l	Meq/l		mg/l	mg/kg	mg/kg
54	8.8	6.8	2.3	2.0	57	9.8	36	3.4	29	4

Undigested					
K (AA)	Zn	Mn	Fe	Cu	SO4-S
mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
111	0.3	2.0	14.0	1.0	190

DTPA Extract				Saturated Paste Extract						
Ni	Pb	Cr	Cd	Hg	As	Se	NO3-N	PO4-P	K	SO4-S
mg/kg	mg/kg	mg/kg	mg/kg	ug/l	ug/l	ug/l	mg/l	mg/l	mg/l	mg/l
0.4	0.6	<0.25	<0.025	14.0	149	16	28	10	4	820

Sal Carollo disk: AGROFORESTRY II file: CAROGROW
last update: 9/24/87

TREE GROWTH DATA

Dec 31, 1986
EUCALYPTUS (rows 1 through 88)
Planting date: May, 1986
ROW 10 FROM S (W-E)

TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)
1	4.6	0.05	20	2.7		39	D		58	3.2		77	6.1	0.35
2	2.4		21	3.2		40	0		59	3.0		78	8.2	0.60
3	2.8		22	4		41	0.3		60	2.7		79	7.6	0.60
4	1.4		23	4.6	0.05	42	0.5		61	2.8		80	6.9	0.50
5	2.6		24	3.6		43	0.5		62	3.6		81	8.0	0.65
6	2.9		25	4.8	0.10	44	D		63	3.7		82	7.7	0.60
7	3.7		26	3.4		45	D		64	4.8	0.05	83	6.5	0.30
8	4.5		27	4.9	0.05	46	0.7		65	4.2		84	7.2	0.55
9	3.6		28	2.7		47	1.1		66	4.5		85	8.2	0.65
10	4.3		29	2.9		48	0.5		67	5.0	0.15	86	5.0	0.10
11	4.2		30	2.0		49	D		68	5.0	0.15	87	2.8	1.00
12	4.8	0.10	31	2.1		50	1.0		69	D		88	D	
13	3.8		32	1.0		51	0.8		70	D		89	1.2	
14	4.8		33	0.6		52	1.5		71	6.1	0.35	90	6.4	0.25
15	3.8		34	d		53	1.4		72	6.5	0.35	91	7.1	0.35
16	2.8		35	0.5		54	1.7		73	7.0	0.60	92	4.5	
17	2.8		36	0.5		55	2.1		74	9.0	0.70			
18	2.5		37	D		56	D		75	7.6	0.50			
19	2.1		38	D		57	2.2		76	7.0	0.60			
subtot	64.4	0.2		43.5	0.2		14.3	0.0		85.7	3.5		93.4	6.5
# of DBH data		2			3			0			9			13

AVERAGE HEIGHT FOR ROW 10 = 3.8 AVERAGE DBH FOR ROW 10 = 0.381 No. dead trees = 12.0

CARDGROW (page 2)

ROW 20 FROM S (E-W) (gypsum row)

TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)
1	7.7	0.45	21	2.5		41	1.3		61	1.0		81	D	
2	7.2	0.40	22	3.3		42	1.2		62	D		82	1.7	
3	7.8	0.50	23	2.3		43	1.7		63	0.9		83	1.0	
4	7.4	0.40	24	1		44	1.0		64	1.4		84	3.7	
5	5.1	0.10	25	3.4		45	0.7		65	0.8		85	D	
6	8.2	0.60	26	2.1		46	D		66	0.9		86	0.7	
7	8.5	0.60	27	3.1		47	0.8		67	1.6		87	2.4	
8	8.2	0.55	28	6.0	0.15	48	1.2		68	1.6		88	4.5	
9	6.5	0.45	29	3.8		49	0.9		69	D		89	3.2	
10	3.7		30	2.1		50	D		70	1.4		90	3.1	
11	7.0	0.50	31	3.5		51	D		71	1.6		91	1.5	
12	7.3	0.40	32	3.1		52	0.9		72	1.0		92	2.0	
13	6.8	0.40	33	3.3		53	0.8		73	1.6		93	2.1	
14	7.1	0.45	34	2.2		54	1.2		74	1.2		94	2.3	
15	7.3	0.45	35	3.0		55	1.1		75	2.1		95	3.4	
16	6.0	0.25	36	1.2		56	D		76	1.8		96	2.9	
17	6.0	0.20	37	1.0		57	1.4		77	1.5		97	2.5	
18	6.5	0.20	38	2.4		58	0		78	2.2		98	3.0	
19	5.3	0.15	39	?		59	0.7		79	?				
20	2.2		40	?		60	0.7		80	?				
subtot	131.8	7.05		49.3	0.15		15.6	0		22.6	0		40	0
# of DBH data		18			1			0			0			0

AVERAGE HEIGHT FOR ROW 20 = 2.91 AVERAGE DBH FOR ROW 20 = 0.379 No. dead trees = 9.0

ROW 40 FROM SOUTH SIDE (W-E)

TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)
1	1.0		26	2.0		51	2.9		76	6.2	0.25	101	2.2	
2	1.4		27	1.7		52	2.2		77	7.9	0.45	102	4.5	
3	0.5		28	2.5		53	4.5		78	6.3	0.30	103	5.3	0.15
4	1.1		29	4.1		54	3.0		79	7.2	0.50	104	5.1	0.15
5	1.4		30	4.5		55	3.3		80	5.6	0.20	105	5.2	0.20
6	1.7		31	3.7		56	3.8		81	5.5	0.15	106	5.3	0.15
7	2.4		32	2.6		57	3.9		82	5.4	0.20	107	5.6	0.25
8	3.0		33	3.1		58	4.3		83	6.5	0.35	108	1.0	
9	2.0		34	2.9		59	1.6		84	7.7	0.40	109	5.2	0.15
10	2.9		35	3.0		60	4.5		85	6.8	0.40	110	6.2	0.30
11	1.9		36	3.3		61	4.0		86	5.7	0.25	111	7.4	0.40
12	3.1		37	4.0		62	3.6		87	7.0	0.55	112	6.7	0.35
13	1.2		38	3.5		63	3.7		88	4.5		113	4.4	
14	1.0		39	3.7		64	4.3		89	5.2	0.20	114	5.1	0.10
15	0.7		40	4.1		65	2.4		90	8.2	0.70	115	6.0	0.15
16	0.2		41	4.3		66	4.4		91	7.0	0.35	116	4.5	
17	0.3		42	3.8		67	7.0	0.40	92	6.8	0.30	117	3.5	
18	2.5		43	2.7		68	5.4	0.20	93	5.0	0.10	118	2.1	
19	0.7		44	4.6	0.05	69	6.1	0.20	94	9.1	0.60	119	4.7	0.10
20	0.6		45	3.3		70	2.4		95	7.7	0.50	120	5.5	0.20
21	0.6		46	4.2		71	2.6		96	7.3	0.40	121		
22	1.9		47	3.0		72	7.0	0.30	97	7.8	0.50	122		
23	1.6		48	4.2		73	7.1	0.60	98	6.3	0.30	123		
24	2.0		49	3.0		74	6.1	0.20	99	6.2	0.25	124		
25	2.7		50	3.6		75	6.2	0.20	100	6.6	0.35	125		
subtot	38.4	0		85.4	0.05		106.3	2.1		165.5	8.55		95.5	2.65
# of DBH data		0			1			7			24			13

AVERAGE HEIGHT FOR ROW 40 = 4.1 AVERAGE DBH FOR ROW 40 = 0.297 No. dead trees = 0.0

ROW 50 FROM SOUTH (E-W)

TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)
1	2.5		20	4.6		39	2.0		58	2.0		77	D	
2	3.7		21	3.6		40	?		59	2.2		78	1.1	
3	2.9		22	2.2		41	2.7		60	2.3		79	1.3	
4	2.0		23	0		42	2.9		61	2.0		80	?	
5	2.2		24	3.3		43	0.9		62	0.9		81	1.7	
6	2.0		25	2.5		44	1.5		63	1.3		82	0.9	
7	2.5		26	1.9		45	2.2		64	1.1		83	2.0	
8	2.1		27	2.0		46	2.0		65	1.0		84	1.6	
9	2.1		28	1.6		47	2.5		66	1.5		85	1.6	
10	2.7		29	2.9		48	1.9		67	1.0		86	2.4	
11	D		30	2.7		49	3.3		68	1.7		87	1.2	
12	2.8		31	2.1		50	2.3		69	1.0		88	0.7	
13	3.9		32	3.7		51	2.0		70	2.2		89	1.7	
14	3.0		33	5.7	0.20	52	4.2		71	1.8		90	1.9	
15	5.1	0.15	34	2.6		53	1.5		72	2.8		91	1.7	
16	2.2		35	3.1		54	1.5		73	3.4		92		
17	4.4		36	3.0		55	1.3		74	1.3		93		
18	3.8		37	D		56	2.5		75	1.4		94		
19	5.0	0.20	38	2.2		57	2.0		76	2.0		95		
subtot	54.9	0.4		49.7	0.2		39.2	0.0		32.9	0.0		19.8	0.0
# of DBH data		2			1			0			0			0

AVERAGE HEIGHT FOR ROW 50 = 2.3 AVERAGE DBH FOR ROW 50 = 0.18 No. dead trees = 4.0

ROW 60 from SOUTH (W-E)

TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)
1	2.3		16	2.0		31	2.5		46	2.0		61	1.3	
2	0.7		17	1.8		32	1.6		47	2.0		62	2.7	
3	3.0		18	2.4		33	0.8		48	3.0		63	7.2	0.50
4	1.8		19	2.3		34	2.0		49	2.7		64	3.3	
5	2.2		20	1.0		35	2.5		50	2.2		65	2.9	
6	1.8		21	1.2		36	2.9		51	3.1		66	5.0	0.15
7	1.7		22	0.6		37	1.5		52	4.4		67	5.6	0.20
8	3.1		23	1.0		38	1.0		53	6.4	0.25	68	6.1	0.20
9	3.5		24	1.0		39	2.6		54	7.0	0.55	69	4.4	
10	1.1		25	1.0		40	?		55	6.1	0.35	70	2.7	
11	1.4		26	1.0		41	2.5		56	3.5		71		
12	1.8		27	0.8		42	2.3		57	D		72		
13	2.4		28	2.0		43	3.2		58	6.0	0.30	73		
14	2.5		29	2.0		44	2.6		59	2.7		74		
15	1.9		30	2.1		45	2.2		60	2.0		75		
subtot	31.2	0.00		22.2	0.00		30.2	0.00		53.1	1.45		41.2	1.05
# of DBH data		0			0			0			4.00			4

AVERAGE HEIGHT FOR ROW 60 = 2.6 AVERAGE DBH FOR ROW 60 = 0.31 No. dead trees = 1

CAROGROW (page 5)

ROW 70 from SOUTH (E-W)

TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)
1	4.0		14	D		27	1.4		40	?		53	3.5	
2	2.6		15	4.1		28	4.6		41	6.4	0.30	54	4.6	
3	1.4		16	D		29	4.5		42	5.8	0.30	55	0.9	
4	D		17	2.4		30	2.0		43	5.7	0.20	56	1.2	
5	D		18	1.3		31	4.7	0.05	44	5.0	0.10	57		
6	D		19	2.2		32	3.6		45	3.6		58		
7	2.0		20	3.2		33	2.4		46	6.3	0.20	59		
8	D		21	5.2	0.2	34	6.7	0.25	47	5.3	0.20	60		
9	D		22	4.7	0.05	35	4.4		48	2.2		61		
10	1.0		23	6.7	0.4	36	6.4	0.25	49	3.9		62		
11	1.1		24	2.0		37	3.6		50	3.6		63		
12	4.4		25	5.7	0.15	38	7.2	0.3	51	3.3		64		
13	4.0		26	6.9	0.3	39	5.0		52	4.6		65		
subtot	20.5	0.0		44.4	1.1		56.5	0.9		55.7	1.3		10.2	0.0
# of DBH data		0			5			4			6			0

AVERAGE HEIGHT FOR ROW 70 = 3.8 AVERAGE DBH FOR ROW 70 = 0.22 No. dead trees = 7

ROW 88 FROM SOUTH (W-E)

TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)
1	0.6		9	3.7		17	2.3		25	3.7		33		
2	2.0		10	3.9		18	3.2		26	3.2		34		
3	2.3		11	2.5		19	3.4		27	2.3		35		
4	2.4		12	1.8		20	2.0		28	3.2		36		
5	2.9		13	3.2		21	3.6		29	2.1		37		
6	2.7		14	3.0		22	3.1		30	1.3		38		
7	3.3		15	3.1		23	2.2		31			39		
8	1.6		16	2.3		24	3.9		32			40		
subtot	17.8	0.00		23.5	0.00		23.7	0.00		15.8	0.00		0.0	0.0
# of DBH data		0			0			0			0			0

AVERAGE HEIGHT FOR ROW 88 = 2.7 AVERAGE DBH FOR ROW 88 = ERR No. dead trees = 0

CASUARINA (rows 89 through 116)

Planting date: June, 1986

ROW 90 FROM SOUTH (E-W)

TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)
1	4.4		9	2.7		17	2.3		25	2.6		33		
2	2.6		10	3.6		18	1.0		26	2.7		34		
3	3.9		11	3.8		19	2.6		27	2.0		35		
4	3.0		12	3.0		20	3.5		28	3.2		36		
5	3.0		13	2.5		21	2.7		29	3.6		37		
6	3.2		14	2.6		22	3.6		30	3.2		38		
7	2.4		15	3.0		23	3.5		31			39		
8	2.7		16	3.2		24	3.7		32			40		
subtot	25.2	0.00		24.4	0.00		22.9	0.00		17.3	0.00		0.0	0.0
# of DBH data		0			0			0			0			0

AVERAGE HEIGHT FOR ROW 90 = 3.0 AVERAGE DBH FOR ROW = ERR No. dead trees = 0

CAROGROW (page 6)

ROW 91 FROM SOUTH (W-E)

TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)
1	2.5		9	3.0		17	2.4		25	3.0		33	3.3	
2	3.5		10	2.0		18	2.6		26	3.3		34	3.7	
3	2.4		11	3.1		19	2.6		27	3.0		35		
4	2.6		12	3.0		20	1.9		28	4.5		36		
5	3.1		13	2.9		21	2.4		29	3.2		37		
6	3.0		14	3.0		22	3.0		30	2.8		38		
7	2.7		15	2.2		23	2.5		31	3.0		39		
8	3.7		16	3.0		24	2.7		32	3.5		40		
subtot	23.5	0.00		22.2	0.00		20.1	0.00		26.3	0.00		7.0	0.0
# of DBH data		0			0			0			0			0

AVERAGE HEIGHT FOR ROW 91 = 2.9 AVERAGE DBH FOR ROW = ERR No. dead trees = 0

ROW 98 FROM SOUTH (E-W)

TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)
1	2.4		9	2.3		17	2.6		25	2.2		33		
2	3.3		10	2.4		18	2.9		26	2.0		34		
3	3.0		11	2.5		19	2.9		27			35		
4	2.3		12	3.7		20	2.1		28			36		
5	2.7		13	4.4		21	3.4		29			37		
6	3.3		14	3.4		22	2.6		30			38		
7	2.8		15	3.0		23	3.6		31			39		
8	2.7		16	2.8		24	2.9		32			40		
subtot	22.5	0.00		24.5	0.00		23.0	0.00		4.2	0.00		0.0	0.0
# of DBH data		0			0			0			0			0

AVERAGE HEIGHT FOR ROW 98 = 2.9 AVERAGE DBH FOR ROW = ERR No. dead trees = 0

ROW 102 FROM SOUTH (W-E)

TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)
1	2.6		6	2.1		11	2.7		16	3.0		21	2.5	
2	2.5		7	2.3		12	3		17	2.6		22	2.7	
3	2.8		8	2.9		13	2.7		18	2.2		23	3.3	
4	2.5		9	3.1		14	2.8		19	3.5		24		
5	1.9		10	2.3		15	2.7		20	3.4		25		
subtot	12.3	0.00		12.7	0.00		13.9	0.00		14.7	0.00		8.5	0.00
# of DBH data		0			0			0			0			0

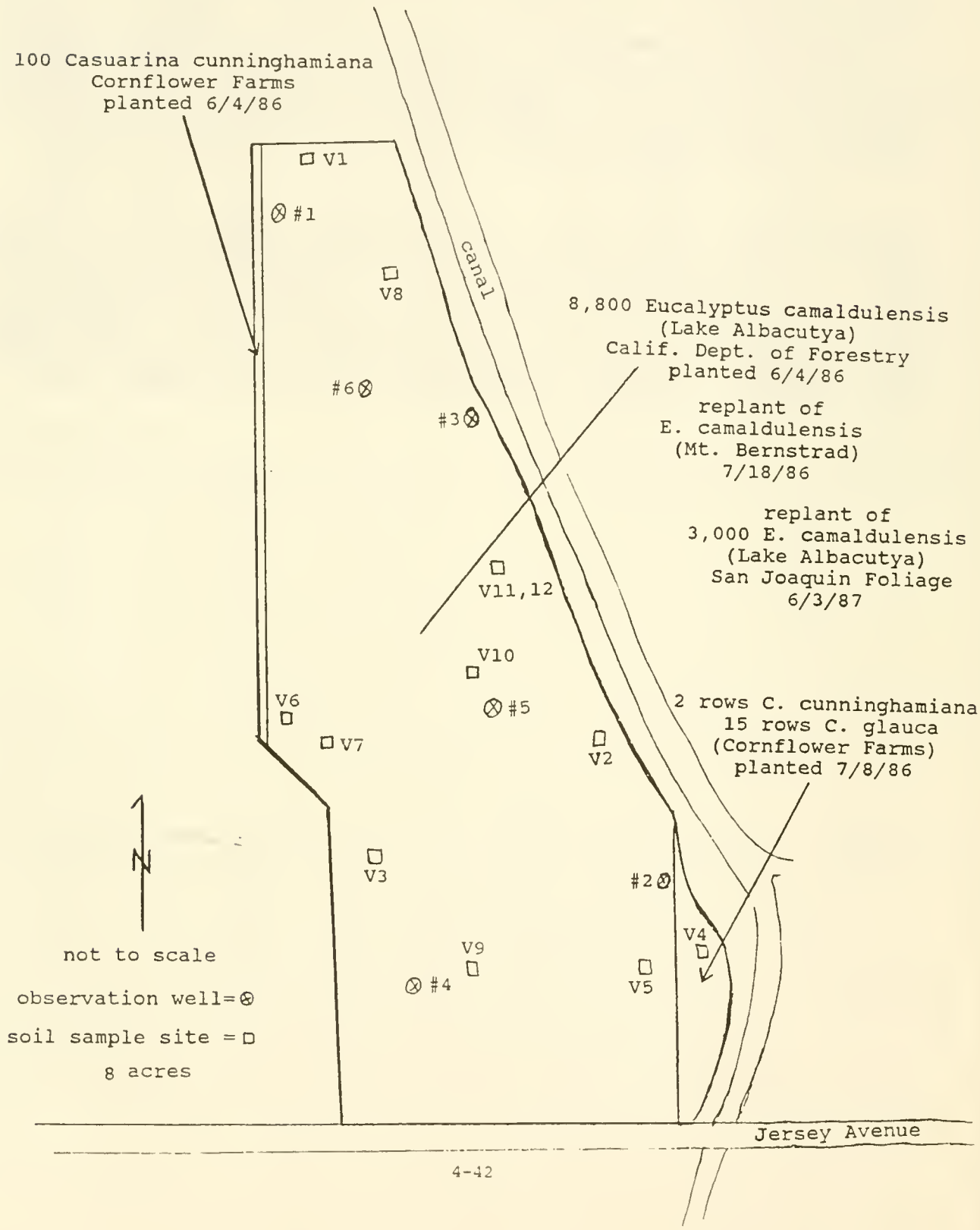
AVERAGE HEIGHT FOR ROW 102 = 2.7 AVERAGE DBH FOR ROW = ERR No. dead trees = 0

4.5 Verdigaal Brothers

In June and July of 1986, 8 acres on the Verdigaal Brothers farm was planted with 8,800 Eucalyptus camaldulensis (Lake Albacutya) and 600 casuarina. Initially, there were high mortality rates and portions of the field had to be replanted. The poor results of the initial planting are thought to have been experienced for two reasons: hot weather (100+ degrees F) and delayed watering at planting time, and highly saline and sodic conditions in portions of the field. Better survival rates were attained with replants which were planted in moist soil and around which the soil had been loosened to allow more water to get to the trees.

The Verdigaal plantation lies above very high water tables, ranging from 3.2 to 5 feet below the ground surface. This may also be contributing to the below average growth rates on this farm. Tree height measurements from 3 typical rows on the plantation showed average heights of about 3 feet at 5 to 6 months of age. The USDA-SCS in Hanford has monitored the water table depth and EC and also has run several detailed analyses of water and soil samples. Samples from this farm have also been sent to Dellavalle Labs for analysis.

VERDIGAAL BROTHERS
AGROFORESTRY DEMONSTRATION PLANTINGS



AGROFORESTRY - TREE PLANTING disc: AGROFORESTRY file: AGFOVERD
last update: 9/30/87

county: KINGS

farm: VEROIGAAL acreage: 8 av.tr/ac: 1175

PLANTINGS

DATE	NURSERY	SOURCE	EUCA-CAM	EUCA-oth	CAS-GLA	CAS-CUN	CAS-oth	POPLAR	MESQUITE	gr.tot.
		total:	8800	0	0	100	500	0	0	9400
6/4/86	CDF	L.ALBACUTYA	8800							
6/4/86	CDF	AUSTRALIA				100				
7/8/86	CORNFL	AUSTRALIA					500			
7/18/86	replant*	MT BERNSTEAD								
6/3/87	SJN(replant)	L.ALBACUTYA		(3000)						

* Unclear planting data

Comments:

Mo./Yr.	7/86	3/87	5/87	9/87
	Euc. from COF not doing as well as others, cas died 2Xs in 1 area. Dug down on replants so that that water > 1 to 2 ft around plant, re-plant after irrig., better survival rate	some trees died back or were damaged by cotton defoliant, Cas. just alive due to Na in soil	New growth looks good other plantings better due to more irrigations	replanted some eucs, (6/87) prob. reason for death - hi SAR due to hi Na

SOILS	Mo./Yr.	2/86	6/86	3/87	5/87	7/87
Lab Analysis:		see VERDSOIL	Ec 15.4 - 4.2 mmhos/cm prior to planting	see VERDSOIL	-	see VERDSOIL
Amendments:			Gypsum applied some years back	none	none	
Fertilizer:			none at this time	none	none	

IRRIGATION WATER

Mo./Yr.	6/86	3/87	5/87
Lab Analysis:	Canal water (used 1st) Ec = 0.04 mmhos/cm irrigation pump water Ec = 3.2 mmhos/cm drainage water Ec = 5.0 - 7.0	2 reports Canal Ec = 0.08 Well Ec = 3.2 & Canal Ec = 0.04 Well & Drain water together Ec = 5.0	none

Amount & Frequency:	86	86	3/87	5/87
	pre-irrig. 5/19. 6/15, 3.2 EC, 6/17 canal 7/7 canal 7/24 canal	8/4 drain, canal 8/18 drain, canal 9/12 canal 9/30 drain	8 times (in 86?)	once this year (3/87)

WATER TABLE

Depths (feet) (7/86 - 10/86 from verdwatr):

	22-Jul-86		29-Sep-86	08-Oct-86						
WELL #	Jul-86	Aug-86	Sep-86	Oct-86	Nov-86	Dec-86	Jan-87	Feb-87	Mar-87	Apr-87
1	3.8		4.5	4						
2	4		3.9	4						
3	3.7		3.7	4.4						
4	4.7		5	4.5						
5	4.5		4.9	4.5						
6	3.8		4.4	4.6						

	27-May-87	25-Jun-87		12-Aug-87
WELL #	May-87	Jun-87	Jul-87	Aug-87
1	3.8	4.6		4.8
2	4.8	4.9		4.2
3	4.6	4.4		4.4
4	5.1	4.6		3.2
5	5	3.6		3.5
6	4.7	3.7		3.65

Lab Analysis: also see VERDWATR

Electric Conductivity (Ec X 1000) of ground water (from verdwater)

WELL #	31-Mar-86				22-Jul-86			08-Oct-86		
	Mar-86	Apr-86	May-86	Jun-86	Jul-86	Aug-86	Sep-86	Oct-86	Nov-86	Dec-86
1	3.3				2.9			2.5		
2	0.98				1.03			0.93		
3	5				0.93			0.54		
4					8.9			12.1		
5					2.8			4.1		
6					1.98			2.04		

								01-Oct-86		
casuarina								19.2		
eucalyptus								32		

WELL #						25-Jun-87		12-Aug-87		
	Jan-87	Feb-87	Mar-87	Apr-87	May-87	Jun-87	Jul-87	Aug-87		
1						1.3		1.5		
2						0.4		0.5		
3						0.4		0.4		
4						5.1		6.6		
5						3.4		2.6		
6						1.7		1.6		

see VERDWATR for more detail

TREES

Mo./Yr.	12/86	3/87	5/87
Growth:	see VERDGROW	ave. ht. = 2.8 ft 13% mortality, 87% survival	new growth looks good

Lab Analysis:

wood	-	-
leaves	-	-

WEEDS

Mo./Yr.	6/86	3/87	5/87
	Fusilade in Eucs but not Cas, 1 treatment killed watergrass & strangletop, burmuda grass showing stress	3 applications Fusilade for Burmuda & Water grass, good results	none yet this year

VERDEGAAL BROS. disc: AGROFORESTRY II file: VERDWATR
last update: 8/14/87

WATER DATA

DATE	SAMPLE #	DEPTH feet	pH	EC x 1000 CATIONS meq/l	ALIQUOT mls	VERSINATE mls	Ca + Mg meq/l	Na meq/l	SAR	ESP	REMARKS
3/31/86	1			3.30 36		1.1	11	25	9	11	
	2			0.98 9.8		0.3	3	9.5	7	9	
	3			5.00 56		3.0	30	26	6	7	
7/22/86	1	3.8		2.9		7.0					
	2	4.0		1.03							
	3	3.7		0.93							
	4	4.7		8.9		20.0					
	5	4.5		2.8							
	6	3.8		1.98							
9/29/86	1	4.5									
	2	3.9									
	3	3.7									
	4	5									
	5	4.9									
	6	4.4									
10/1/86	casuarina		9.1	19.2 248		0.80	8.0	240	120	124	Barely alive
	eucalypt.		9.4	32.0 420		0.90	9.0	411	194	197	Planted 3 times & died 3 times
10/8/86	1	4.0		2.5 27			4.0	23	16	17	
	2	4.0		0.93 9.3			2.0	7.3	7.3	7.9	
	3	4.4		0.54 5.4			1.7	3.7	4	5	
	4	4.5		12.10 150			15.0	135	49	53	
	5	4.5		4.1 47			2.8	44.2	37	41	
	6	4.6		2.04 22			2.0	20	20	23	

5/4/87
Dellavalle Labs
Undigested Sample

EC dS/m	Ca Meq/l	Mg Meq/l	Na Meq/l	SAR	SAR adj	Cl Meq/l	CO3+HCO3 Meq/l	SO4-S mg/l	B mg/l	NO3-N mg/l	Fe mg/l
6.56	7.2	8.1	63.6	23.0	68.8	10.8	22.8	690	1.3	4.6	<0.1

Mn mg/l	Li mg/l	F mg/l	pH
0.3	<0.04	1.3	7.6

Digested Sample

P mg/l	K mg/l	Zn mg/l	Mn mg/l	Na mg/l	Fe mg/l	Cu mg/l	Ca mg/l	Mg mg/l	Be mg/l	V mg/l	Pb mg/l
1.6	4.4	0.6	0.62	1430	3.6	0.7	118	106	<0.025	<0.8	0.2

Cr mg/l	Cd mg/l	As ug/l	Hg ug/l	Se ug/l	Mo mg/l	Al mg/l	Si mg/l
<0.25	<0.025	20	<0.2	<2	0.8	3.3	7.7

VERDEGAAL BROS.

disc: AGROFORESTRY II file: VERDSOIL
last update: 8/31/87

SOIL DATA

DATE	SAMPLE #	DEPTH inches	pH	EC x 1000	CATIONS meq/l	ALIQUOT mls	VERSINATE mls	Ca + Mg meq/l	Na meq/l	SAR	ESP	TOTAL SALTS meq/l	REMARKS
1/31/86	1	0 - 12		4.2			3.3	33	14	3	3	47	see map
	1	12 - 24		8.9			7.1	71	38	6	7	109	in file
	2	0 - 12		15.4			0.4	4.0	190	134	66	194	for sample
	2	12 - 24		5.9			0.4	4.0	64	45	39	68	locations
	3	0 - 12		5.6			0.4	4.0	60	42	36	64	
	3	12 - 24		8.8			0.7	7.0	101	54	43	108	
3/86	1	0 - 12		7.2			1.0						
	1	12 - 24		3.0			0.60						
	1	24 - 36		2.6			0.40						
	2	0 - 12		5.9			1.0						
	2	12 - 24		1.47			0.20						
	2	24 - 36		1.57			0.20						
	3	0 - 12		11.5			0.50						
	3	12 - 24		15.8			1.0						
	3	24 - 36		9.80			0.30						
3/31/86	V-1	0 - 12		3.30	36		1.1	11	25	9	11		
	V-2	0 - 12		0.98	9.8		0.3	3	9.5	7	9		
	V-3	0 - 12		5.00	56		3.0	30	26	6	7		
7/22/86	V-6	0 - 12	3.9	38	550		26+	260	290	1.49	1.60		Planted twice & died, acid dump area
10/1/86	V-4	0 - 12	9.1	19.2	248		0.80	8.0	240	120	124		Casuarina, just living
	V-5	0 - 12	9.4	32.0	420		0.90	9.0	411	194	197		Eucalyptus, planted 3 times & died 3 times
10/7/86	V-7	0 - 18	7.5	7.5	90		4.5	45	45	9.48	9.70		Trees 3-4'tall,near acid area 10' E
	V-8	0 - 18	8.3	1.97	19		0.3	3	16	13	15		Trees 2-3' tall
10/13/86	V-9	0 - 18	9.2	20.1	270		1.2	12.0	255	104	107		Trees dead, twice
	V-10	0 - 18	9.5	11.9	149		0.2	2.0	147	147	150		Trees dead, twice
	V-11	0 - 12	8.1	12.1	150		2.3	23	127	11	14		Trees alive
	V-12	12 - 24	8.6	0.54	5.4		0.1	1.0	4.4	6	7		

VERDSOIL (continued)

Dellavalle Labs
5/5/87

Undigested										
SP	pHs	ECe	Ca	Mg	Na	Cl	ESP	B	NO3-N	PO4-P
		dS/m	Meq/l	Meq/l	Meq/l	Meq/l		mg/l	mg/kg	mg/kg
35	9.2	10.1	1.7	1.2	103	20.6	56	3.9	4	20

Undigested					
K (AA)	Zn	Mn	Fe	Cu	SO4-S
mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
1139	1.1	4.3	6.0	0.4	440

DTPA Extract				Saturated Paste Extract						
Ni	Pb	Cr	Cd	Hg	As	Se	NO3-N	PO4-P	K	SO4-S
mg/kg	mg/kg	mg/kg	mg/kg	ug/l	ug/l	ug/l	mg/l	mg/l	mg/l	mg/l
0.4	0.4	<0.25	<0.025	<0.2	51	14	2	20	369	1500

VERDIGAAL BROTHERS

disk: AGROFORESTRY II file: VERDGROW
last update: 8/31/87

TREE GROWTH DATA

Dec 29, 1986

ROW 6 (S-N)

TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)
1	2.5		14	2.8		27	3.0		40	1.7		53	2.5	
2	0		15	2.2		28	3.3		41	1.9		54	1.4	
3	0.9		16	3.7		29	2.9		42	3.3		55	3.0	
4	2.6		17	3.8		30	3.5		43	2.2		56	3.8	
5	4.5		18	3.9		31	3.1		44	2.8		57	1.7	
6	4.0		19	1.0		32	0.6		45	2.5		58	2.5	
7	5.5		20	4.5		33	3.6		46	2.7		59	2.0	
8	2.8		21	2.5		34	4.8		47	D		60	2.1	
9	3.0		22	2.9		35	3.5		48	4.8		61	1.4	
10	D		23	0.9		36	1.0		49	1.0		62	2.5	
11	D		24	3.4		37	2.9		50	1.6				
12	2.5		25	2.4		38	2.2		51	2.6				
13	1.3		26	1.0		39	2.8		52	1.4				
	29.6			35.0			37.2			28.5			22.9	

AVERAGE HEIGHT FOR ROW 6 = 2.64 Number of dead trees = 4

ROW 16 (S-N)

TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)
1	3.8		20	1.7		39	3.6		58	3.9		77	D	
2	4.0		21	0.6		40	1.4		59	3.8		78	2.2	
3	4.9		22	4.6		41	3.0		60	4.6		79	3.3	
4	3.9		23	4.5		42	1.7		61	3.5		80	1.5	
5	2.8		24	3.6		43	3.0		62	0.8		81	0.6	
6	3.8		25	1.8		44	5.1		63	2.1		82	2.0	
7	2.7		26	0		45	3.4		64	0.9		83	D	
8	2.3		27	3.4		46	3.0		65	2.3		84	D	
9	4.7		28	2.6		47	3.3		66	2.0		85	1.3	
10	3.0		29	4.0		48	2.6		67	3.3		86	1.4	
11	4.0		30	3.4		49	1.3		68	5.0		87	2.8	
12	6.7		31	3.5		50	4.6		69	4.1		88	D	
13	4.0		32	2.0		51	4.2		70	2.3		89	D	
14	2.5		33	4.6		52	3.9		71	4.3		90	D	
15	2.7		34	4.0		53	D		72	2.4		91	0.9	
16	2.5		35	2.2		54	2.8		73	3.5		92	0.5	
17	4.5		36	D		55	4.6		74	2.4		93	D	
18	2.5		37	2.3		56	3.1		75	1.0				
19	0.9		38	3.9		57	2.7		76	0.4				
	66.2			52.7			57.3			52.6			16.5	

AVERAGE HEIGHT FOR ROW 16 = 2.96 Number of dead trees = 10

ROW 26 (S-N)

TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)
1	4.3		28	D		55	2.9		82	3.0		109	2.9	
2	3.8		29	D		56	3.9		83	1.0		110	1.8	
3	5.6		30	D		57	2.8		84	D		111	2.9	
4	3.8		31	2.5		58	3.3		85	D		112	3.6	
5	5.4		32	2.5		59	4.5		86	0.6		113	1.3	
6	2.8		33	3.2		60	D		87	1.2		114	2.6	
7	2.5		34	2.5		61	3.9		88	1.4		115	2.7	
8	4.4		35	4.6		62	4.2		89	0.5		116	1.6	
9	3.5		36	0.9		63	3.5		90	0.7		117	1.9	
10	5.0		37	4.0		64	3.0		91	D		118	0.9	
11	3.7		38	4.4		65	4.4		92	0.6		119	1.3	
12	D		39	3.6		66	D		93	0.9		120	1.0	
13	2.4		40	2.0		67	1.5		94	1.2		121	2.4	
14	4.1		41	4.0		68	4.0		95	1.9		122	1.9	
15	4.2		42	4.0		69	1.3		96	2.5		123	3.5	
16	4.0		43	4.5		70	3.8		97	3.0		124	3.7	
17	4.6		44	5.6		71	4.8		98	0.7		125	3.5	
18	4.7		45	3.6		72	2.5		99	0.7		126	2.4	
19	2.2		46	1.0		73	4.2		100	0.6		127	1.7	
20	2.5		47	2.4		74	2.9		101	D		128	D	
21	2.4		48	6.6		75	1.0		102	D		129	D	
22	D		49	6.3		76	3.4		103	D		130	D	
23	D		50	5.5		77	3.2		104	D		131	1.0	
24	D		51	5.0		78	3.0		105	D		132	D	
25	D		52	2.8		79	2.6		106	1.2				
26	D		53	3.5		80	3.7		107	2.8				
27	2.5		54	4.1		81	3.7		108	3.3				
	78.4			89.1			82			27.8			44.6	

AVERAGE HEIGHT FOR ROW 26 = 2.95

Number of dead trees = 23

4.6 Haynes

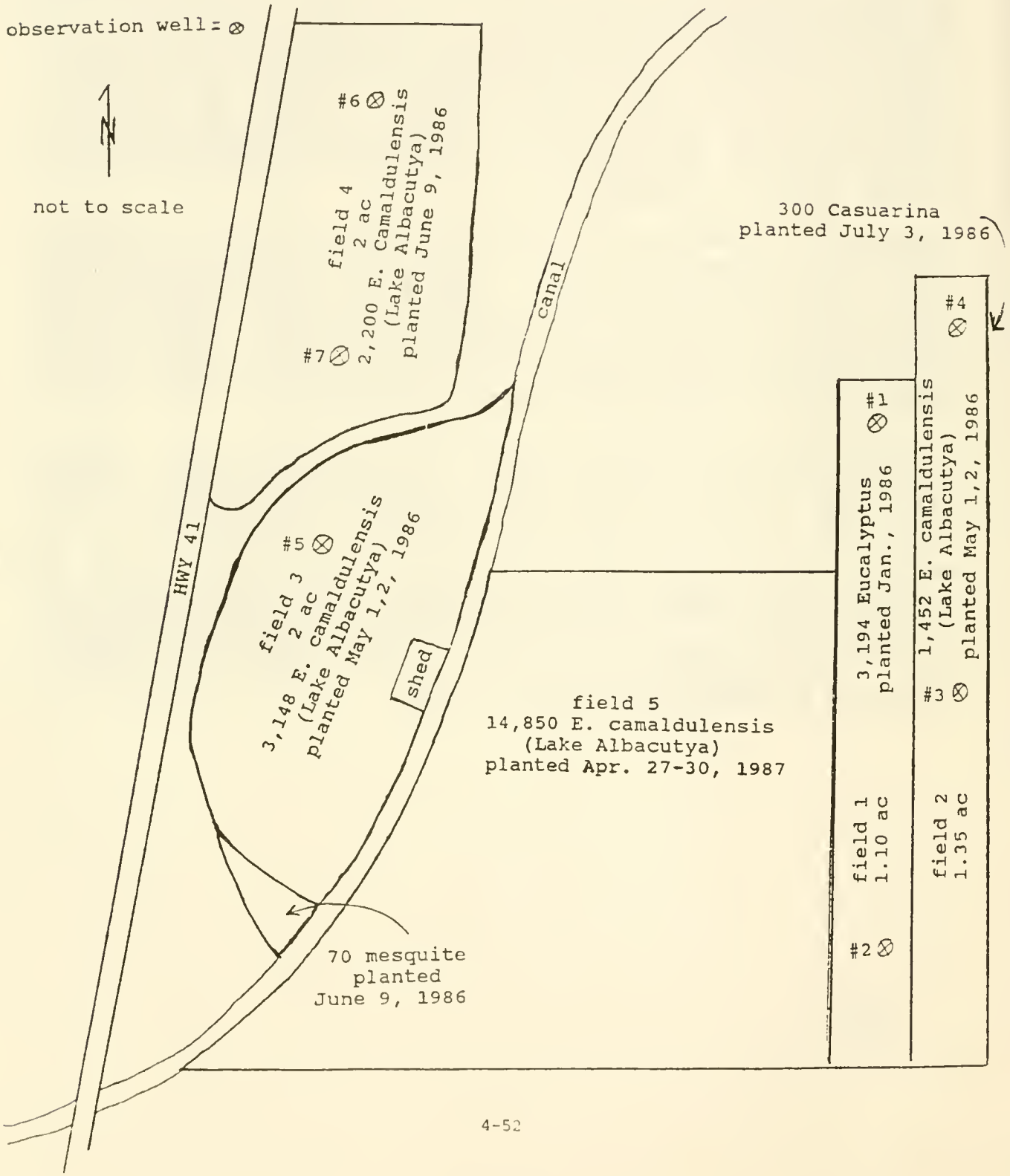
Jim Haynes planted one acre of eucalyptus in January of 1986, before he actually joined the Agroforestry Demonstration Program. Although nearly 1/3 of the seedlings were lost to frost damage, the trees were originally spaced at 3' X 5' so that densities sufficient for study remained after the initial mortalities. In May and June of 1986 approximately 5 1/2 more acres of eucalyptus were planted as part of the Agroforestry Demonstration Program. Poplars, mesquite, and casuarina were also planted on the farm in April, June, and July, respectively. In April of 1987 an additional 10,000 seedlings were planted. At approximately six months of age the trees showed variable growth, depending on the soil conditions, ranging from under 2 feet in highly saline areas to over 10 feet in the better soils.

Because this planting is surrounded by native habitat rather than cultivated fields it has experienced more severe pest problems than most of the other farms. Within one week of planting rabbits had destroyed 95% of the casuarina. Plastic guards were effective in protecting the remaining seedlings. The rabbits damaged some of the eucalyptus but did not appear to like to eat them as they did the casuarina. The poplars are barely staying alive and have suffered from grasshopper damage.

An interesting dilemma has arisen in relation to weed control. Although the field has many weeds, when extensive weed control was tried in one area the rabbits moved in and damaged or killed the trees. Very little weed control has been implemented.

This agroforestry planting is monitored by the Hanford office of the USDA-SCS. Results of previous monitoring and analyses are in the farm report. This farm is also part of the CSUF - Department of Biology wildlife study, which is further discussed in Section 7.0. Cuttings from the two-year-old trees will be used for the selection and propagation study in 1988.

HAYNES AGROFORESTRY DEMONSTRATION PLANTINGS



AGROFORESTRY - TREE PLANTING disc: AGROFORESTRY file: AGFOHAYN
last update: 9/30/87

county: KINGS

farm: HAYNES acreage: 11.3 av.tr/ac: 2253

PLANTING

DATE	NURSERY	SOURCE	EUCA-CAM	EUCA-oth	CAS-GLA	CAS-CUN	CAS-oth	POPLAR	MESQUITE	gr.tot.
		total:	21650	3194	0	0	300	250	70	25464
1/86	plant 1 acre Eucalyptus			3194						
4/23/86	DULAS	CHAPMAN						250		250
5/1/86	SJN	L.ALBACUT	4600							4600
5/28/86	replanted 10%, 145 trees?									
6/9/86	CDF	L.ALBACUT	2200							2200
6/9/86	UCR	Hemet forliso, New Mexico, West Moreland							70	70
7/3/86	CORNFL	AUSTRALIA					300			300
7/18/86	replant 288 trees?									
10/86	replanted some casuarina?									
4/11/87	CDF	L.ALBACUTYA	14850							

Comments:

Mo./Yr.	4/86	10/86	3/87	5/87	9/87
	Jan. spacing 3' X 5' lost ~33% of Jan. planting, mainly due to frost, over irrigating So. end, but corrected	rabbits destroyed 95% of the casuarina immed. aft. planting, installed protectors, mesq. spacing 10'X10' poplars just staying alive, grasshopper damage	Rabbits eat casuarinas w/o guards, some small Euc. w/ D<1/4 inch cut down, not eaten	Due to dry year rabbit problems are severe, new planting spaced 5'X4' (? see 9/87 entry)	1987 planting on 6 ac, spacing 3.5'X 5'

SOILS	Mo./Yr.	86	3/87	5/87
Lab Analysis:		saline sodic w/ Ca+Mg, trees do well with EC 20.2 or 13,184 ppm Ca+Mg 32mg/l, take longer w/ 0 Ca+Mg also see HAYNSOIL	see HAYNSOIL	see HAYNSOIL
Amendments:			none	none
Fertilizer:		none	tablespoon 15-15-15 per tree	tablespoon 15-15-15 per tree, 3 applic. from 1/87 to 5/87

IRRIGATION WATER
Lab Analysis:

Date	canal Ec X 1000	well Ec X 1000
86	0.04 (25 ppm)	ave 1.4 (895 ppm) little/no Ca+Mg
Mar-87	0.08	0.27 to 1.27
May-87	0.04	1.2 to 2.0

Amount & Frequency:	Mo./Yr. 86	3/87	5/87
	Apr,May,Jun 1X a week, over irrig., July 2,13 or 8+18?, Aug 13, 8?, Sept 1, 2Xs in Oct	Field: 1 2 times 2 Avg @ 3 wk 3 Avg @ 2 wk 4 2 times	FIELD: 1 1 time 2 1 time 3 @ 2 weeks 4 bef. & aft. planting

WATER TABLE

Water Table Depths (feet)(4/86 - 10/86 from haynwatr):

	08-Apr-86 Apr-86	24-Apr-86 Apr-86	22-Jul-86 Jul-86	01-Oct-86 Oct-86	May-87
NE well	18	32			
NW well	18				
E side				0.67	
WELL #					
1		6.2	7		>7
2		6.5	7.4		7.2
3		9	7.6		7.3
4			7		8.1
5			5.8		6.5
6			6		6.6
7			5.5		6.1

Lab Analysis:

Electric Conductivity (Ec X 1000) OF GROUND WATER (from haynwatr)

	08-Apr-86 Apr-86	24-Apr-86 Apr-86	22-Jul-86 Jul-86	01-Oct-86 Oct-86
NE well	0.17	0.90		
NW well	0.25			
E side				9.6
WELL #				
1		0.77		
2		3.0	2.8	
3		2.8	4.3	
4			1.2	
5			22.2	
6			0.50	
7			44.0	

See HAYNWATR for more detail

TREES: Mo./Yr.	12/86	3/87	5/87
Growth:	see HAYNGROW	Field 1 ave. 5 ft, 31% died (69% survival)	excellent Field 3 (irrigated @ 2 weeks) other fair to good
Lab Analysis:			
wood	-	-	
leaves	-	-	

WEEDS				
Mo./Yr.	86	3/87	5/87	
	very little or no weed control, when tried extensive control in one area rabbits moved in	-	no control	

HAYNES disc: AGROFORESTRY II file: HAYNWATR
last update: 9/1/87

WATER DATA

DATE	SAMPLE #	DEPTH feet	pH	EC x 1000	CATIONS meq/l	ALIQUOT mls	VERSINATE mls	Ca + Mg meq/l	Na meq/l	SAR	ESP	REMARKS
4/8/86	NE well	18		0.17	1.7		0.1	1.0	0.7	1.0	0.7	
	NW well	18		0.25	2.5		0.2	2.0	0.5	0.4	0.7	
4/24/86	NE well	32		0.90	9.0		0.3	3.0	6.0			
	1	6.2		0.77								
	2	6.5		3.0								
	3	9.0		2.8								
7/22/86	1	7.0										
	2	7.4		2.8	30							
	3	7.6		4.3	48							
	4	7.0		1.2	12							
	5	5.8		22.2	300		4.7	47	253			
	6	6.0		0.50	5.0							
	7	5.5		44.0	640		62.0	620	20			

Wells # 1 - 4 east of canal
Wells # 5-7 west of canal

HAYNES disc: AGROFORESTRY II file: HAYNSOIL
last update: 9/1/87

SOIL DATA

DATE	SAMPLE #	DEPTH inches	pH	EC x 1000	CATIONS meq/l	ALIQUOT mls	VERSINATE mls	Ca + Mg meq/l	Na meq/l	SAR	ESP	REMARKS
4/86	well 2 #1	0 - 12		20.2	260		3.2	32	228	57	59	
	well 2 #2	12 - 24		24.8	400		3.9	39	361	82	88	
	well 2 #3	24 - 40		22.7	290		3.3	33	257	63	67	
	well 1	0 - 12		1.51	15.0		0.1	1.0	14.0	20	22	
	well 3	0 - 12		4.6	52.0		0.6	6.0	51.4	30	30	
	near tree	0 - 12		7.6	90.0		2.9	29	61	16	15	
10/1/86	1	0 - 8	9.5	9.6	118		0.10	1.0	117	165	169	East side N.S. middle dead trees
	2	0 - 8	8.5	5.0	56			7.1	48.9	26	28	Trees alive 6 - 7' tall
	3	0 - 8	8.2	52.6	700			67	633	109	116	Dead, planted twice
12/86	well 1 #1	0 - 12	8.4	18	230		3.3	30.3	200	52	45	planted 5-6-86
	well 1 #2	12 - 24	8.5	33	450		6.0	60	390	71	68	trees 3'- 4' tall
	well 1 #3	24 - 36	8.5	32	420		9.0	90	330	49	45	
	well 1 #4	36 - 48	8.6	80	1100		21.5	210.5	890	271	263	
	well 1 #5	48 - 52	8.4	53	790		14.5	140.5	650	78	75	
4/87	field #3	0 - 12	9.0	25.5	340		1.8	18.0	322	107		dead trees

HAYNES disk: AGROFORESTRY II file: HAYNGROW

TREE GROWTH DATA

Dec, 1986

EAST FIELD
ROW 6 FROM EAST SIDE (N-S)

TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)
1	0.7		28	1.8		55	0.1		82	D		109	6.2	0.30
2	3.1		29	1.8		56	D		83	0.5		110	6	0.25
3	0.2		30	D		57	D		84	D		111	8.0	0.53
4	0.4		31	1.8		58	D		85	D		112	5.6	0.15
5	?		32	1.9		59	0.1		86	D		113	6.3	0.35
6	1.6		33	0.2		60	D		87	2.0		114	6	0.20
7	1.8		34	D		61	D		88	4.0	0.10	115	3.8	
8	D		35	0.9		62	D		89	3.9		116	4.7	0.05
9	D		36	3.8		63	D		90	1.2		117	D	
10	0.2		37	D		64	D		91	4.0		118	4.4	
11	D		38	3.5		65	0.6		92	5.9	0.25	119	4.2	
12	D		39	4.6		66	D		93	5.0	0.10	120	4.3	
13	D		40	D		67	D		94	6.1	0.25	121	D	
14	D		41	D		68	D		95	5.0	0.10	122	2.D	
15	3.0		42	D		69	D		96	4.4		123	D	
16	3.0		43	D.4		70	D		97	4.7	0.05	124	0.8	
17	1.5		44	D		71	D		98	4.2		125	1.0	
18	3.6		45	D		72	D		99	5.5	0.15	126	D	
19	6.3	0.25	46	0.3		73	D		100	1.6		127	2.0	
20	3.1		47	D		74	2.6		101	5.5	0.15	128	D	
21	D		48	0.7		75	4.D		102	4.0		129	D	
22	D		49	0.7		76	5.3	0.10	103	4.0		130	D	
23	1.9		50	D		77	0.6		104	5.3	0.15	131	D	
24	D		51	D		78	D		105	7.2	0.35			
25	1.9		52	D		79	5.3	0.15	106	4.9	0.10			
26	D		53	D		80	4.0		107	5.3	0.20			
27	D		54	D		81	4.7	0.05	108	6.8	0.25			
subtot	32.3	0.25		22.4	0.00		27.3	0.30		101	2.20		65.3	1.83
# of DBH data		1			0			3			14			7

AVERAGE HEIGHT FOR ROW 6 = 1.99 AVERAGE DBH FOR ROW 6 = 0.183 No. dead trees = 54.0

NORTHWEST FIELD
ROW 8 FROM EAST (N-S)

TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)
1	2.6		20	1.3		39	D		58	2.6		77	1.9	
2	3.3		21	3.7		40	0.2		59	D		78	?	
3	2.0		22	4.6		41	2.5		60	2.2		79	?	
4	5.5		23	3.4		42	2.1		61	D		80	3.0	
5	3.0		24	1.0		43	D		62	2.3		81	D	
6	4.2		25	3.0		44	D		63	2.3		82	2.9	
7	4.2		26	D		45	D		64	1.0		83	2.6	
8	3.7		27	2.3		46	D		65	2.6				
9	3.6		28	0.6		47	0.5		66	2.4				
10	2.4		29	D		48	D		67	1.3				
11	4.4		30	0.2		49	2.0		68	D				
12	4.3		31	0.3		50	0.2		69	D				
13	4.0		32	2.2		51	1.6		70	2.0				
14	4.2		33	4.5		52	D		71	?				
15	1.5		34	3.4		53	2.1		72	1.6				
16	4.5		35	0.1		54	D		73	1.3				
17	3.3		36	0.1		55	2.7		74	D				
18	3.3		37	3.4		56	2.5		75	1.0				
19	1.4		38	2.3		57	3.3		76	2.0				
	65.4			36.4			19.7			24.6			10.4	

AVERAGE HEIGHT FOR ROW 8 = 2.45 No. dead trees = 16.0

NORTHWEST FIELD
ROW 16 FROM EAST (N-S)

TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)
1	D		18	D		35	D		52	D		69	2.7	
2	0.4		19	D		36	D		53	D		70	3.4	
3	0.3		20	D		37	1.9		54	D		71	D	
4	2.0		21	D		38	D		55	1.8		72	D	
5	D		22	D		39	D		56	3.3		73	D	
6	D		23	D		40	2.6		57	2.6		74	D	
7	0.4		24	D		41	D		58	D		75	D	
8	0.4		25	D		42	D		59	1.0		76	D	
9	0.4		26	D		43	2.1		60	2.0		77	D	
10	2.2		27	D		44	3.3		61	1.8				
11	2.0		28	D		45	4.4		62	1.2				
12	1.0		29	D		46	D		63	D				
13	D		30	D		47	D		64	D				
14	D		31	D		48	0.9		65	D				
15	D		32	D		49	2.7		66	D				
16	D		33	D		50	D		67	D				
17	D		34	D		51	D		68	D				
subtot	9.1	0.0		0.0	0.0		17.9	0.0		13.7	0.0		6.1	0.0
# of DBH data		0			0			0			0			0

AVERAGE HEIGHT FOR ROW 16 1.9 AVERAGE DBH FOR ROW 16 = ERR No. dead trees = 52

SOUTHWEST FIELD
ROW 15 FROM SOUTH (E-W)

TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)
1	3.5		5	4.5	0.125	9	3.7		13	0.1875		17	1.1	
2	3.9		6	4.5	0.125	10	3.7		14	0.125		18	D	
3	3.9		7	5.9	0.1875	11	3.5		15	3.8		19	4.0	
4	2.1		8	3.9		12	2.3		16	2.3				
subtot	13.4	0.0		18.8	0.4		13.2	0.0		6.4	0.0		5.1	0.0
# of DBH data		0			3			0			0			0

AVERAGE HEIGHT FOR ROW 15 = 3.2 AVERAGE DBH FOR ROW 15 = 0.146 No. dead trees = 1

SOUTH WEST PLANTING
ROW 31 FROM S (E-W)

TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)
1	6.0	0.2	11	D		21	4.5		31	2.0		41	3.4	
2	5.9	0.2	12	0		22	2.5		32	4.0		42	4.0	
3	6.8	0.25	13	4.6		23	2.0		33	3.0		43	2.0	
4	8.6	0.4	14	7.3	0.5	24	0		34	3.0		44	1.4	
5	2.5	0.4	15	6.5	0.3	25	D		35	D		45	D	
6	6.4	0.3	16	7.8	0.4	26	4.7		36	D		46	D	
7	3.3		17	1.2		27	3.0		37	1.6		47	0	
8	0.3		18	7.2	0.35	28	5.5	0.15	38	0				
9	0.3		19	7.2	0.4	29	4.3		39	1.6				
10	D		20	9.0	0.7	30	5.0	0.1	40	0				
subtot	40.1	1.8		50.8	2.7		31.5	0.3		15.2	0.0		10.8	0.0
# of DBH data		6			6			2			0			0

AVERAGE HEIGHT FOR ROW 31 = 4.2 AVERAGE DBH FOR ROW 31 = 0.332 No. dead trees = 12

SOUTHWEST PLANTING
ROW 40 FROM SOUTH (W-E)

TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)
1	4.0		9	D		17	5.5	0.15	25	4.0		33	7.6	0.4
2	4.5		10	1.0		18	4.9	0.10	26	7.9	0.4	34	9.7	0.7
3	7.6	0.4	11	4.5		19	4.0		27	9.8	0.8	35	6.1	0.2
4	7.2	0.3	12	2.5		20	2.8		28	7.5	0.6	36	5.0	0.2
5	8.6	0.6	13	4.0		21	1.6		29	9.3	0.7	37	7.2	0.3
6	7.6	0.4	14	4.8	0.05	22	1.2		30	10.4	0.8	38	5.2	0.1
7	6.2	0.25	15	3.5		23	1.7		31	8.3	0.6	39	2.7	
8	1.3		16	4.9	0.05	24	2.8		32	6.6	0.25	40	2.6	
subtot	47.0	2.0		25.2	0.1		24.5	0.3		63.8	4.2		46.1	1.9
# of DBH data		5			2			2			7			6

AVERAGE HEIGHT FOR ROW 40 = 5.3 AVERAGE DBH FOR ROW 40 = 0.380 No. dead trees = 1.0

SOUTHWEST PLANTING
ROW 58 FROM SOUTH (E-W)

TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)
1	4.9	0.10	9	8.3	0.50	17	6.4	0.25	25	3.5		33	1.6	
2	D		10	9.2	0.70	18	3.2		26	3.0		34	D	
3	2.5		11	9.3	0.70	19	2.3		27	2.3		35	D	
4	4.0		12	7.7	0.50	20	2.5		28	D		36	D	
5	2.9		13	8.1	0.60	21	1.0		29	2.7		37	D	
6	7.6	0.35	14	10.8	0.80	22	2.4		30	D				
7	6.1	0.30	15	8.9	0.70	23	2.3		31	3.3				
8	5.2	0.15	16	8.5	0.80	24	D		32	2.3				
subtot	33.2	0.9		70.8	5.3		20.1	0.3		17.1	0.0		1.6	0.0
# of DBH data		4			8			1			0			0

AVERAGE HEIGHT FOR ROW 58 = 4.9 AVERAGE DBH FOR ROW 58 = 0.496 No. dead trees = 8.0

SOUTHWEST PLANTING
ROW 74 FROM SOUTH (W-E)

TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)	TREE #	HEIGHT (feet)	DBH (inches)			
1	1.2		9	9.2		17	8.3	0.50	25	6.3	0.10			
2	2.4		10	9.3	0.70	18	10.2	0.90	26	7.0				
3	5.8	0.20	11	10.2	1.00	19	8.0	0.52	27	4.0				
4	8.8	0.50	12	9.8	1.01	20	7.5	0.40	28	3.0				
5	5.0	0.20	13	7.0	0.40	21	7.0	0.35	29	5.0				
6	1.4		14	4.5	0.10	22	3.5		30	6.5	0.25			
7	9.3	0.55	15	10.3	1.10	23	6.7	0.25	31	5.0	0.10			
8	9.8	0.60	16	9.9	1.00	24	3.7	0.30						
subtot	43.7	2.1		70.2	5.3		54.9	3.2		36.8	0.5		0.0	0.0
# of DBH data		5			7			7			3			0

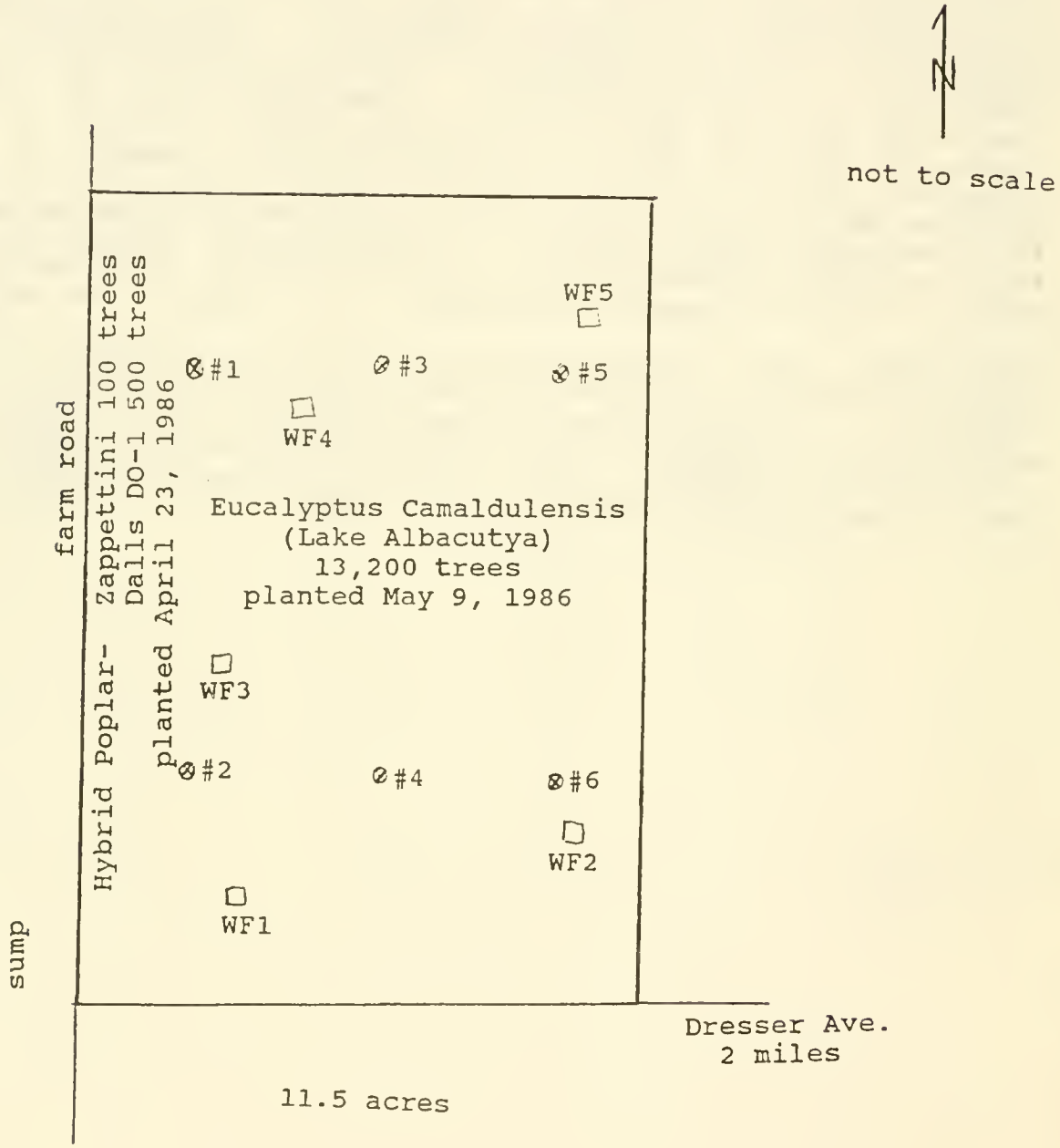
AVERAGE HEIGHT FOR ROW 74 = 6.6 AVERAGE DBH FOR ROW 74 = 0.501 No. dead trees = 0.0

4.7 Way Farms

The Way Farms agroforestry plantation was planted with 600 poplar cuttings and 11,900 Eucalyptus camaldulensis seedlings (Lake Albacutya seed source) in April and May of 1986. Some of the poplar cuttings were held in cold storage for one month prior to planting and this appears to have had an effect on their growth. They were slower at leafing out and a few of the cuttings died. The Oregon poplar variety has grown well, reaching heights of about 6 feet only 6 months after planting. The eucalyptus have grown well, with the exception of those in the north east corner where the soil is highly saline. Some leaf damage was experienced by trees on the north end due to cotton defoliant. The leaves spotted but did not fall and the trees recovered by the beginning of 1987. Although the lower 1/3 of the field was in standing water for most of the winter, the trees do not appear to have been adversely affected. No weed control has been used on this field and although there is a weed problem, once the trees grow to a suitable height they appear to out-compete the weeds.

Observation well monitoring and lab analysis of water and soil samples have been performed by the Bakersfield office of the USDA-SCS. In addition, soil and water samples taken in May 1987 were sent to Dellavalle Labs. These results are included in the following farm report. Trees from this farm will be used next year in the selection and propagation study.

WAY FARM AGROFORESTRY PLANTINGS



observation well = ⊗

soil sample area = □

AGROFORESTRY - TREE PLANTING disc: AGROFORESTRY file: AGFOWAY
last update: 9/3/87

county: KERN

farm: WAY acreage: 11.5 av.tr/ac: 1087

PLANTINGS

DATE	NURSERY	SOURCE	EUCA-CAM	EUCA-oth	CAS-GLA	CAS-CUN	CAS-oth	POPLAR	MESQUITE	gr.tot.
		total:	11900	0	0	0	0	600	0	12500
4/23/86	ZAPATTINI							100		
4/23/86	OULAS	CHAPMAN						500		
5/9/86	CDF	L.ALBACUT	11900							

Comments:

Mo./Yr.	5/86	3/87	6/87
	poplar planting, some cuttings show buds, others still dormant, few dead, maj. look good, Zappattini look poor (held in cold storage 1 month), Euc look good	Leaf damage on No. end from cotton defoliants leaves spotted but no leaf fall, some frost, cultivated 1X, some trees dying lower 1/3 field in standing water	Appear to have recovered from fall cotton defoliant damage. Healthier than in Jan. NE portion of field remains marginal in tree prodn. & size

SOILS Mo./yr. 86

Lab Analysis: see WAYSOIL, see file for description of soils in area

Sample	Ec	SAR
1	1.4	71
2	2.9	12
3	3.7	17
4	1.2	65
5	15.6	39

(sample depth = 3.6")

3/87

7/87 see WAYSOIL

Quarter	3/87
Amendments:	-
Fertilizer:	-

IRRIGATION WATER

Quarter	3/87
Lab Analysis:	-
Amounts & Frequency:	-

WATER TABLE

Depth:

WELL #	28-Oct-86 Oct-86	Nov-86	Dec-86	Jan-87	Feb-87	Mar-87	Apr-87	May-87	Jun-87
3	4.9			4.9					3.9
4	5.4			5					4.6
5	5.6			5.8					3.8
6	5.2			5.3					4.3
7	6.3								4.3

Lab Analysis: also see WAYWATR

WELL #	28-Oct-86 Oct-86 Ec	Nov-86	Dec-86	Jan-87	Feb-87	Mar-87	Apr-87	May-87	Jun-87 Ec
3	3.6								2.6
4	5.5								6.6
5	3.2								9.3
6	3.6								4.8
7									6.9
ditch									1.1

WELL #	Oct-86 SAR	Nov-86	Dec-86	Jan-87	Feb-87	Mar-87	Apr-87	May-87	Jun-87 SAR
3	37								20.4
4	42								44.9
5	31								79.1
6	38								35.4
7									47.4
ditch									6.53

conflicting report (DBASE 870618)

	EC Oct-86	SAR Oct-86
3	3.6	37
4	5.5	42
5*	4.7	31
6*	3.2	22
7*	3.6	38

for more detail see WAYWATR

TREES

Mo./Yr.	10/86	3/87	6/87
Growth:	doing exceptionally well, ave 5-6', smallest in areas of high salinity w/ 6'+ trees on outer perimeter, Oregon poplar about 6' & look strong	ave. Euc. 5 to 6 ft., poplar ave. 6 ft. (in 3/87 report but same as 10/86) 1"-2" new growth also see WAYGROW	see map in file for visual aspects ave 8"-12" new growth also see WAYGROW

Lab Analysis:

wood -

leaves -

WEEDS

Mo./Yr.	3/87	6/87
	no herbicides	plagued with weeds (from Williams report)

WAY FARMS

disc: AGROFORESTRY II file: WAYWATR

last update: 9/3/87

WATER DATA

DATE	WELL #	DEPTH feet	pH	EC x 1000 mmhos	CATIONS meq/l	ALIQUOT mls	VERSINATE mls	Ca + Mg meq/l	Na meq/l	SAR	ESP	TOTAL SALTS meq/l
10-28-86	3	4.9		3.6			0.2	2	37	37		39
	4	5.4		5.5			0.4	4	60	42		64
	5	5.6		4.7			0.5	5	49	31		54
	6	5.2		3.2			0.4	4	31	22		35
	7	6.25		3.6			0.1	1	38	38		39
Jan 87	3	4.9										
	4	5										
	5	5.8										
	6	5.3										
6-15-87	3	3.9		2.6		1	0.3	3	25	20.4		28
	4	4.6		6.6		1	0.5	5	71	44.9		76
	5	3.8		9.3		1	0.5	5	125	79.1		130
	6	4.3		4.8		1	0.4	4	50	35.4		54
	7	4.3		6.9		1	0.5	5	75	47.4		80
	ditch	0		1.1		1	0.3	3	8	6.53		11

Ditch is located along west boundary of agroforestry field

5/5/87

Dellavalle Labs

Well #4 (see map in file for location)

Undigested Sample

EC	Ca	Mg	Na	SAR	SAR	Cl	CO3+HCO3	SO4-S	B
dS/m	Meq/l	Meq/l	Meq/l		adj	Meq/l	Meq/l	mg/l	mg/l
2.57	5.7	2.2	20.5	10.3	25.8	10.0	9.5	1100	1.5

NO3-N	Fe	Mn	Li	F	pH
mg/l	mg/l	mg/l	mg/l	mg/l	
0.3	<0.1	<0.05	<0.04	0.66	7.3

Digested Sample

P	K	Zn	Mn	Na	Fe	Cu	Ca	Mg	Be
mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
0.3	9.6	0.1	0.05	293	0.6	<0.1	89.2	26.8	<0.025

V	Pb	Cr	Cd	As	Hg	Se	Mo	Al	Si
mg/l	mg/l	mg/l	mg/l	ug/l	ug/l	ug/l	mg/l	mg/l	mg/l
<0.08	0.2	<0.25	<0.025	6	3.9	<2	<0.1	0.7	18.9

WAY FARMS disc: AGROFORESTRY II file: WAYSOIL

last update: 9/3/87

SOIL DATA

DATE	SAMPLE #	DEPTH inches	EC X 1000 mmhos	TOTAL SALTS meq/l	VERSINATE TITRATION	Ca+Mg meq/l	Na meq/l	SAR	REMARKS
6-23-87	1	0 - 6	2.6						non-saline
	1	12	1.0						non-saline
	2	0 - 6	9.6						moderately saline
	2	12	8.4						moderately saline
10-28-86	1	3 - 6	1.4	14	0.4	4	10	7.1	see map in
	2	3 - 6	2.9	32	0.8	8	24	12	file for
	3	3 - 6	3.7	42	0.8	8	34	17	locations
	4	3 - 6	1.2	11	0.3	3	8	6.5	
	5	3 - 6	15.6	200	3.6	36	164	39	

Dellavalle Labs

5/5/87

	Undigested								
SP	pHs	ECe dS/m	Ca Meq/l	Mg Meq/l	Na Meq/l	Cl Meq/l	ESP	B mg/l	NO3-N mg/kg	PO4-P mg/kg
35	7.9	3.1	8.2	2.6	22	19.2	11	1.4	4	10

Undigested					
K (AA) mg/kg	Zn mg/kg	Mn mg/kg	Fe mg/kg	Cu mg/kg	SO4-S mg/kg
272	2.3	16.0	31.0	3.2	66

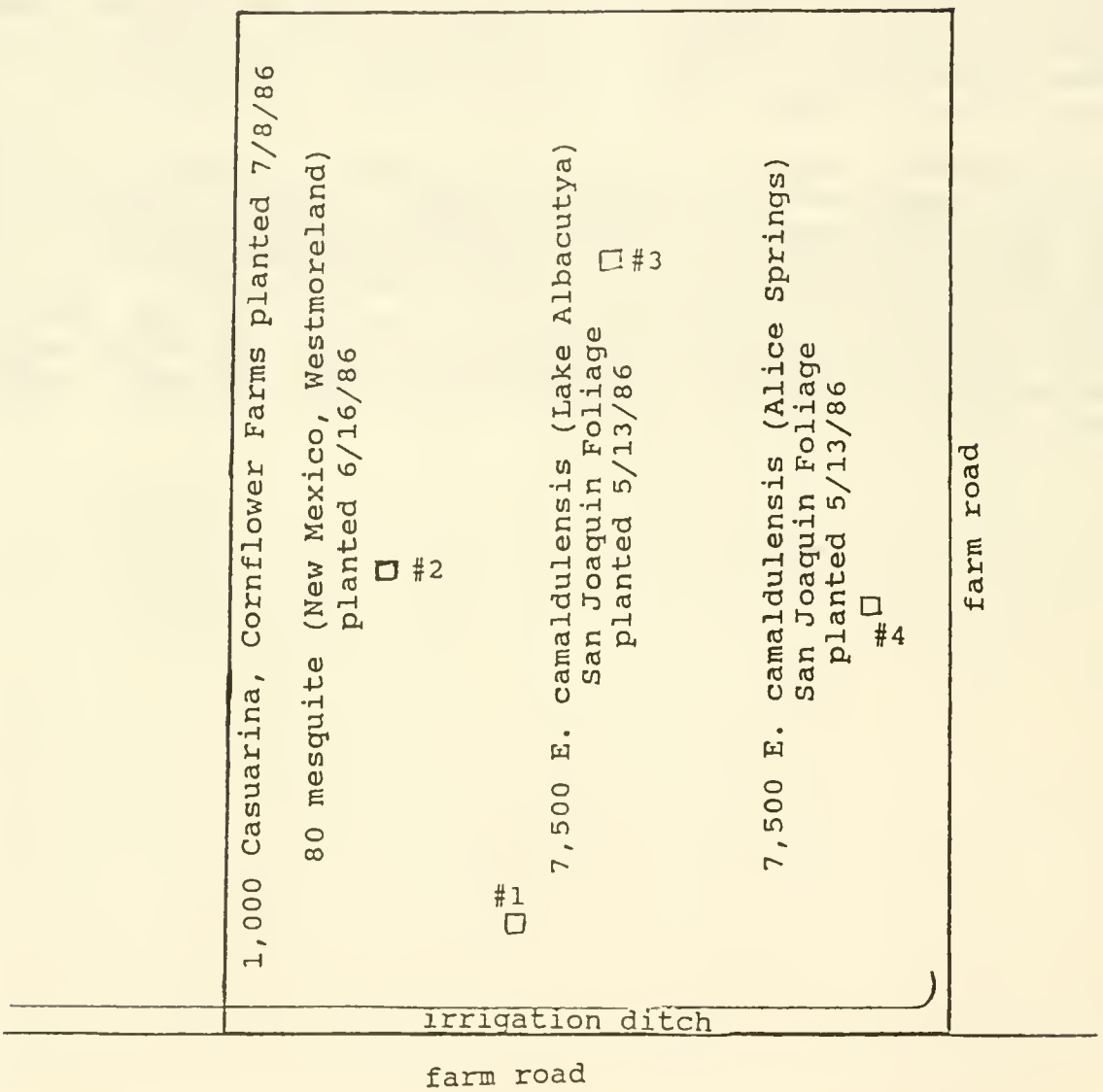
DTPA Extract				Saturated Paste Extract						
Ni mg/kg	Pb mg/kg	Cr mg/kg	Cd mg/kg	Hg ug/l	As ug/l	Se ug/l	NO3-N mg/l	PO4-P mg/l	K mg/l	SO4-S mg/l
1.0	1.2	<0.25	0.092	1.2	58	2	0.3	5	15	190

4.8 Arthur Williams & Sons

Thirteen acres on the Williams farm were planted with 15,000 Eucalyptus camaldulensis (half from Alice Springs and half from Lake Albacutya), 1,000 casuarina, and 80 mesquite (from New Mexico and West Moreland) in May, June, and July of 1986. A high mortality rate (around 50%) was experienced with the seedlings; this is thought to have been caused by high air and soil temperatures at the time of planting and high soil salinity. The tendency of the soil to crack as it dries, tearing the roots of the plants apart, may also have contributed to the mortality problem. The casuarina were hand planted and immediately irrigated with good water and thus faired better than the previously planted eucalyptus, for which irrigation was delayed for 1 to 2 days after planting. Although the casuarina suffered animal damage (rabbits), they have regrown. By the beginning of 1987 surviving trees ranged from 6 to 6.5 feet in height. The field has not been weeded and thus suffers from heavy weed competition.

Soil analyses, taken in November of 1986 from areas with average growth, poor growth, no growth of trees but growth of weeds, and no growth of trees or weeds, revealed that those areas in which all of the seedlings had died had SAR levels (see glossary) twice those for the areas in which the trees had survived. The best growth occurred in the area with the lowest EC and SAR readings. The USDA-SCS in Bakersfield conducts the soil and water analyses and monitors the site. Details of the above mentioned analyses can be found in the farm report.

WILLIAMS AGROFORESTRY DEMONSTRATION PLANTINGS



13 acres
not to scale

soil sample area = □

AGROFORESTRY - TREE PLANTING disc: AGROFORESTRY file: AGFOWILL
last update: 9/3/87

county: KERN

farm: WILLIAMS acreage: 13 av.tr/ac: 1237

PLANTING DATE	NURSERY	SOURCE	EUCA-CAM	EUCA-oth	CAS-GLA	CAS-CUN	CAS-oth	POPLAR	MESQUITE	gr.tot.
		total:	15000	0	0	0	1000	0	80	16080
5/13/86	SJN	ALICE SPR	7500							
		L ALBACUT	7500							
6/16/86	UCR	NEW MEX.							80	
		W MORELND								
7/8/86	CORNFL	AUSTRALIA					1000			

Comments:

Mo./Yr	6/86	7/86	3/87	6/87
	Euc doing poorly, ~50% loss, planted between furrows so there would be no problem wetting, as soil dries it forms cracks, some roots torn apart, tire damage noted, rec'd freq. irrig. keep ground moist	hand planted casuarina, immed. followed w/ irrig. water, so far look good, cas suffered rodent damage, is regrowing	high mortality, probably due to high Na in soil, 100 F+ during planting, mortality now stabilized	Information from WAY file

SOILS also see WILLSOIL
site description in file

Lab Analysis: 6/23/86

Sample Depth	EC
0-6"	8.4
12"	44.0

Nov. 86

Sample #	Ec	SAR
1	14.6	32
2	24	78
3	15.4	38
4	7.6	61

(taken at 3 to 8 in. depth)

Mo./Yr.	3/87
Amendments:	-
Fertilizer:	-

IRRIGATION WATER

Mo./Yr.	3/87	6/87
Lab Analysis:	-	EC X 1000 / 0.3 (well water) see WILLWATR for detailed analysis

Amounts and Frequency: - irrig. 3 times since Jan. 1, currently using 24 hr sets, last irrig. completed June 4

WATER TABLE

Depth:

	29-Oct-86 Oct-86
WELL # 1	5.15
WELL # 2	9.0

Lab Analysis: -

Electric Conductivity (EC)

	29-Oct-86 Oct-86
WELL # 1	0.9
WELL # 2	2.4

SAR

	29-Oct-86 Oct-86
WELL # 1	8
WELL # 2	19.0

TREES Mo./Yr.	1/87	3/87	6/87
Growth:	height ranges from inches to 6-6.5 ft	-	see map in file for visual aspect

Lab Analysis:

wood -

leaves -

WEEDS

Mo./Yr.	9/86	3/87	6/87
	weed competition is bad	-	field plagued with weeds

ARTHUR WILLIAMS & SONS

disc: AGROFORESTRY II file: WILLWATR
last update: 9/17/87

WATER DATA

DATE	WELL #	DEPTH feet	pH	EC x 1000 mmhos	CATIONS meq/l	ALIQUOT mls	VERSINATE mls	Ca + Mg meq/l	Na meq/l	SAR	ESP	TOTAL SALTS meq/l	REMARKS
29-Oct-86	1	5.15		0.9						8			
	2	9.0		2.4						19			
26-Jun-87	Irrig. Ditch	n/a		0.3		1	0.1	1	2	3		3	Irrigation water

ARTHUR WILLIAMS & SONS

disc: AGROFORESTRY II file: WILLSOIL
last update: 9/3/87

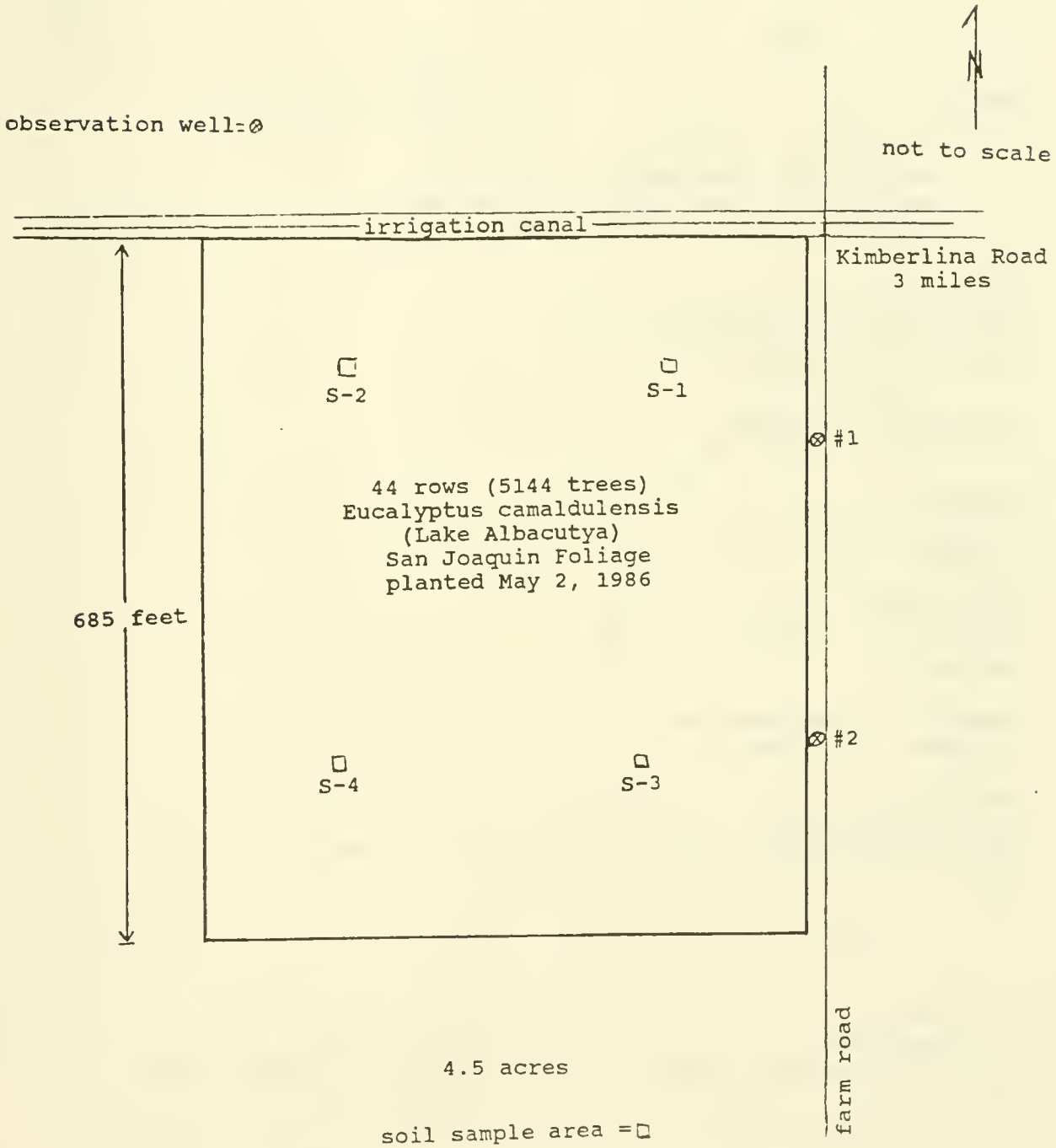
SOIL DATA

DATE	SAMPLE #	DEPTH inches	pH	EC x 1000	CATIONS meq/l	ALIQUOT mls	VERSINATE mls	Ca + Mg meq/l	Na meq/l	SAR	TOTAL SALTS meq/l	REMARKS
6/3/86	1	0 - 6		8.4								very strongly saline
	2	12		44.00								
11/4/86	1	3 - 6		14.6			4.3	43	147	32	190	see map in file
	2	3 - 6		24			2.8	28	292	78	320	for locations
	3	3 - 6		15.4			3.5	35	160	38	195	
	4	3 - 6		7.6			0.4	4	86	61	90	

4.9 Buttonwillow Land and Cattle Co.

Although nearly 1/3 of the 4.5 acres of Eucalyptus camaldulensis planted on this trial plantation died soon after planting, the remainder of the field has done surprisingly well. These trees ranged from 4 to 6 feet in height five months after planting, with 25% to 30% around 6 feet tall. Soil samples analysed by the USDA-SCS in Bakersfield revealed that the areas of initial die-off were very strongly saline and sodic. Surviving trees were in moderately saline and slightly sodic and in slightly saline soils. Soil samples from this farm have also been sent to Dellavalle Labs for analysis. These analyses are included in the farm report. Because these trees seem to be growing well under saline conditions cuttings will be used in 1988 for the selection and propagation project.

BUTTONWILLOW LAND CO.
AGROFORESTRY DEMONSTRATION PLANTINGS



AGROFORESTRY - TREE PLANTING disc: AGROFORESTRY file: AGFOBUTT
last update: 9/10/87

county: KERN

farm: BUTTONWILLOW acreage: 4.5 av.tr/ac: 1143

PLANTING

DATE	NURSERY	SOURCE	EUCA-CAM	EUCA-oth	CAS-GLA	CAS-CUN	CAS-oth	POPLAR	MESQUITE	gr.tot.
		total:	5144	0	0	0	0	0	0	5144
5/2/86	SJN	L.ALBACUT	5144							

Comments:

Mo./Yr.	5/86	3/87	6/87
	spacing 88" X 5', upper ~1/3 looks dead, prob. salinity, rest looks good	initial die off stabilized, hi Ec & SAR in mortality area (1/3 area)	Status has remained the same since last report Report in WAY file

SOILS

Ground condition at time of planting:
1st 1/3? cloddy & rough, last 3/4? looked good
See file for soil description

Lab Analysis: see BUTTSOIL

Mo./Yr.	3/87	7/87
Amendments:	-	
Fertilizer:	-	

IRRIGATION WATER

Mo./Yr	5/86	3/87
Lab Analysis:		-
Amount & Frequency:	hand watered with 1 qt/tree	-

WATER TABLE

Water Table Depth feet):

DATE	29-Oct-86	Nov-86	Dec-86	Jan-87	Feb-87	Mar-87	Apr-87	May-87	Jun-87
WELL #									
1	5.15							dry	4.8
2	9.01								7.3

Lab Analysis:
Ec of Ground Water

DATE	29-Oct-86	Nov-86	Dec-86	Jan-87	Feb-87	Mar-87	Apr-87	May-87	Jun-87
WELL #									
1	0.88								1.02
2	2.4								6.3

SAR of Ground Water

DATE	29-Oct-86	Nov-86	Dec-86	Jan-87	Feb-87	Mar-87	Apr-87	May-87	Jun-87
WELL #									
1	8								12.7
2	19								61.2

see BUTTWATR for more detail

TREES

Mo./Yr.	10/86	6/87
Growth:	4 - 6 ft w/ 25-30% at 6', doing well except in high Na areas,	see map in file for specific height & new growth

Lab Analysis:

wood	-
leaves	-

WEEDS

Quarter	3/87
	-

BUTTONWILLOW LAND CO. disc: AGROFORESTRY II file: BUTTWATR
last update: 9/10/87

WATER DATA

DATE	WELL #	DEPTH feet	pH	EC x 1000 mmhos	CATIONS meq/l	ALIQUOT mls	VERSINATE mls	Ca + Mg meq/l	Na meq/l	SAR	ESP	TOTAL SALTS meq/l	REMARKS
29-Oct-86	1	5.15		0.88			0.2	2	8	8		10	
	2	9.01		2.4			0.3	3	23	19		26	
05-May-87	1	well dry											
26-Jun-87	1	4.8		1.02		1	0.1	1	9	12.7		10	
	2	7.3		6.3		1	0.3	3	75	61.2		78	

BUTTONWILLOW FARMS disc: AGROFORESTRY II file: BUTTSOIL
last update: 9/10/87

SOIL DATA

DATE	SAMPLE #	TEXTURE	pH	EC X 1000 mmhos	TOTAL SALTS meq/l	VERSINATE TITRATION	Ca + Mg meq/l	Na meq/l	SAR	REMARKS
23-Jul-86	S-1	c	8.5	45	640	17.2	34.4	606	146	very strongly saline & sodic
	S-2	c		25	350	16.6	33.2	317	77	very strongly saline & sodic
	S-3	c		8.7	100	18	36	64	15	mod. saline & slightly sodic
	S-4	c		6.9						slightly saline
see map in file for sample locations										
Nov-86	1			14.6					32	
	2			24					78	
	3			15.4					38	
	4			7.6					61	

Dellavalle Labs
5/5/87

				Undigested						
SP	pHs	ECe dS/m	Ca Meq/l	Mg Meq/l	Na Meq/l	Cl Meq/l	ESP	B mg/l	NO3-N mg/kg	PO4-P mg/kg
75	8.1	13.8	25	4.9	134	55	33	3.7	6	49

Undigested					
K (AA) mg/kg	Zn mg/kg	Mn mg/kg	Fe mg/kg	Cu mg/kg	SO4-S mg/kg
481	3.5	9.8	46.0	4.8	739

DTPA Extract				Saturated Paste Extract						
Ni mg/kg	Pb mg/kg	Cr mg/kg	Cd mg/kg	Hg ug/l	As ug/l	Se ug/l	NO3-N mg/l	PO4-P mg/l	K mg/l	SO4-S mg/l
0.2	1.2	<0.25	0.1	4.6	18	<2	0.4	5	294	1680

SECTION 4.10

Allen Ranch

AGROFORESTRY - TREE PLANTING disc: AGROFORESTRY file: AGFOALLE
last update: 9/17/87

county: FRESNO

farm: ALLEN acreage: 5 av.tr/ac: 1400

PLANTING DATE	NURSERY	SOURCE	EUCA-CAM	EUCA-oth	CAS-GLA	CAS-CUN	CAS-oth	POPLAR	MESQUITE	gr.tot.
		total:	6500	0	0	0	500	0	0	7000
7/9/86	SJN	L.ALBACUT	6500							
?	?	?					500			
?	SJN	MT BERNSTEAD	?							

Comments:

Mo./Yr.	3/87	6/87
	look very good, trees staked	doing very well, well cared for, blanks will be replanted w/trees from other plantings in the area, outer row of cas on windward side appears to be a good practice

SOILS	Mo./Yr.	3/87
Lab Analysis:		none
Amendments:		none
Fertilizer:		none

IRRIGATION WATER

Mo./Yr.	3/87
Lab Analysis:	Ec of sump water= 7.0
Irrigation Amounts and Frequency:	sprinkler, ~1.5 ac. ft

WATER TABLE
Depth (feet):

	29-Oct-86		30-Dec-86		26-Feb-87		20-Apr-87	29-May-87	23-Jun-87	20-Jul-87
	Oct-86	Nov-86	Dec-86	Jan-87	Feb-87	Mar-87	Apr-87	May-87	Jun-87	Jul-87
north end	5.67		5.58		4.67		4.5	3.42	5	5.33
south end	6		6.17		5.83		4.83	5.5	4.58	5.5

Lab Analysis:
Electric Conductivity (Ec) of Water Table

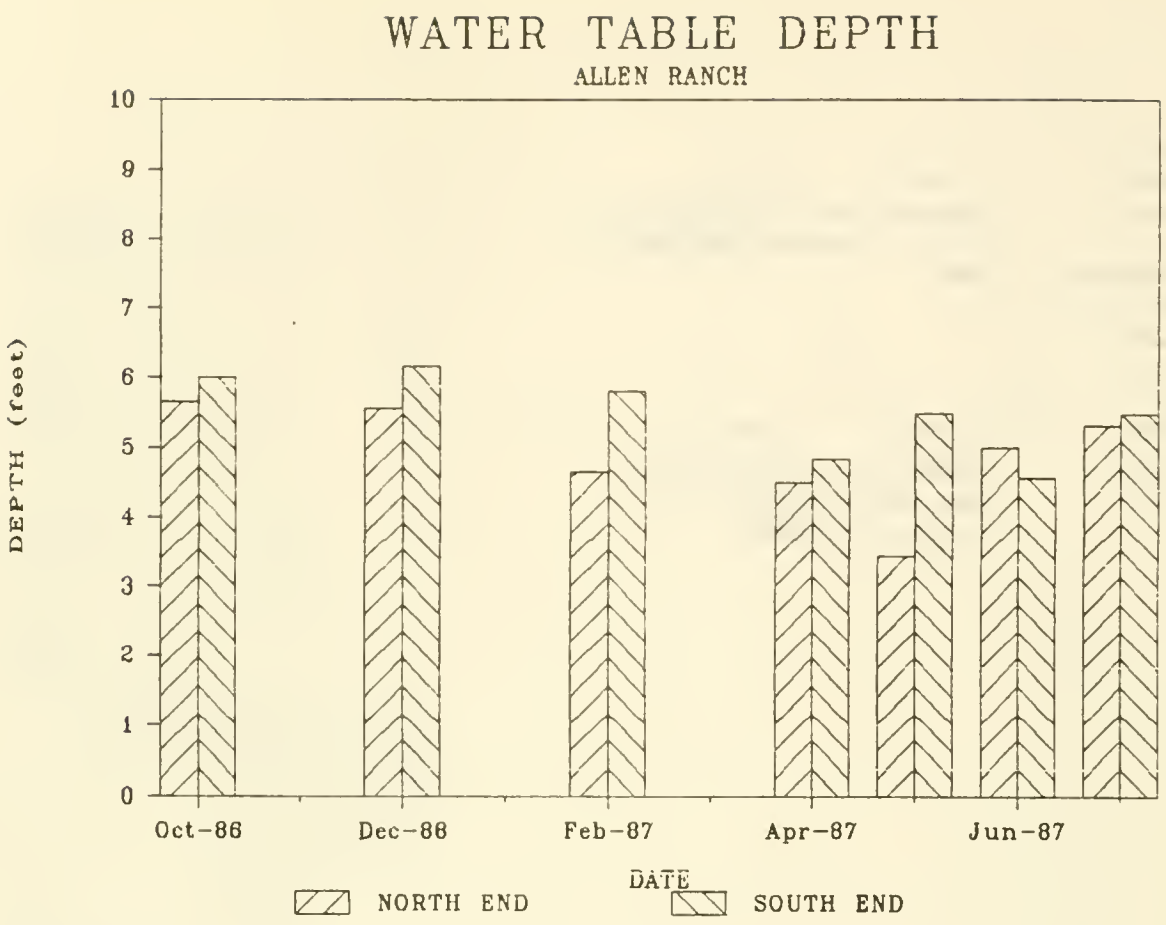
	29-Oct-86				26-Feb-86		20-Apr-87	29-May-87	23-Jun-87	20-Jul-87
	Oct-86	Nov-86	Dec-86	Jan-87	Feb-86	Mar-87	Apr-87	May-87	Jun-87	Jul-87
north end	11				10.3		9.9	8.7	9.78	9.76
south end	4.3				3.7		5.2	5.8	6.44	6.40

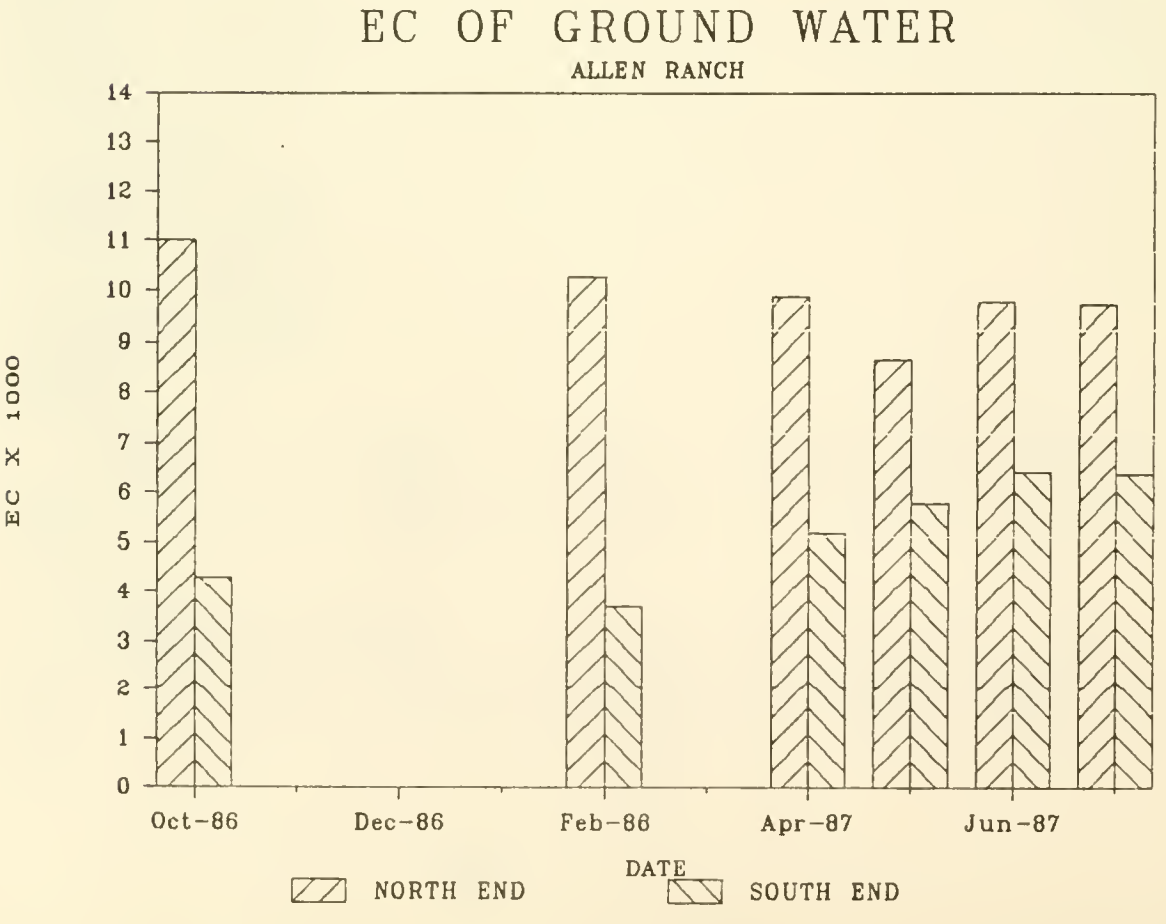
TREES

Mo./Yr.	3/87	6/87
Growth:	no record	ave. ht. -5 ft. survival rate >95%
Lab Analysis:	none	
Wood		
Leaves		

WEEDS

Mo./Yr.	3/87	6/87
	Adequate, Chem. sprays & by hand	Fusilade & Goal in combinaton with Roundup


WATER TABLE DEPTH
ALLEN RANCH
DEPTH (feet)
10
9
8
7
6
5
4
3
2
1
0
Oct-86
Dec-86
Feb-87
Apr-87
Jun-87
DATE
NORTH END
SOUTH END


EC OF GROUND WATER
ALLEN RANCH
EC X 1000
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Oct-86
Dec-86
Feb-86
Apr-87
Jun-87
DATE
NORTH END
SOUTH END

SECTION 4.11

Kings Boys Ranch

AGROFORESTRY - TREE PLANTING disc: AGROFORESTRY file: AGFOBOYS
last update: 9/17/87

county: KINGS

farm: KINGS BOYS RANCH acreage: 1.93 av.tr/ac: 1140

PLANTING

DATE	NURSERY	SOURCE	EUCA-CAM	EUCA-oth	CAS-GLA	CAS-CUN	CAS-oth	POPLAR	MESQUITE	gr.tot.
		total:	2200	0	0	0	0	0	0	2200
6/17/86	CDF	L.ALBACUT	2200							
7/18/86	Replants? Mt. Bernstead									

? wind break trees, Rose Gum & Mana Gum?

Comments:

Mo./Yr	86	3/87
	hard time estab. Euc, lost >50% from 1st planting	soils hi in Na,low in Ca+Mg, water standing in furrows since Oct 1

SOILS

Lab Analysis: see BOYSSOIL

Mo./Yr.	86	3/87
Amendments:	--	pit run gypsum around each tree
Fertilizer:	~5 tons dairy manure before planting	none

IRRIGATION WATER

Mo./Yr. 3/87

Lab Analysis:
Canal Ec = 0.10
Pump Ec = 1.7
pH = 9.5
Ca+Mg = 1.0
Na = 16
N = 0.15
(no units given)

Amount & Frequency: 1986

well Ec = 1.27

6/18	pum	9/10
6/30	canl	9/23
7/18		10/5
7/29		10/20
8/4 (?#)		11/9
8/18		

WATER TABLE		
Mo./Yr.	7/86	3/87
Depth (feet):	ave. 2 holes = 10.6	10.7
Lab Analysis:	-	-
TREES Mo./Yr.		3/87
Growth:		Ave growth 2.2 ft 17% died(83% surv.) Mt. Benstead out-grow Albacutya
Lab Analysis:		
wood		-
leaves		-
WEEDS Quarter	86	3/87
	disked between rows & hoed around some trees	no control, furrow between rows twice

BOYS RANCH disc: AGROFORESTRY II file: BOYSWATR
last update: 8/21/87

WATER DATA

DATE	SAMPLE #	DEPTH feet	pH	EC x 1000	CATIONS meq/l	ALIQUOT mls	VERSINATE mls	Ca + Mg meq/l	Na meq/l	SAR	ESP	REMARKS
7/86	average 2 holes	10.6										
3/87		10.7										

BOYS RANCH disc: AGROFORESTRY II file: BOYSSOIL
last update: 8/21/87

SOIL DATA

DATE	SAMPLE #	DEPTH inches	pH	EC x 1000	CATIONS meq/l	ALIQUOT mls	VERSINATE mls	Ca + Mg meq/l	Na meq/l	SAR	ESP	REMARKS
7/86	alive		9.2	8.4	100			2.0	98	98		
	dead		10.7	18.6	240			1.0	239	341		

SECTON 4.12

Bloemhof Agricultural Enterprises

AGROFORESTRY - TREE PLANTING disc: AGROFORESTRY file: AGFOBLOE
last update: 9/17/87

county: KERN

farm: BLOEMHOF acreage: 18.7 av.tr/ac: 1738
some tree replants, info est. 1146 trees/ac

PLANTING

DATE	NURSERY	SOURCE	EUCA-CAM	EUCA-oth	CAS-GLA	CAS-CUN	CAS-oth	POPLAR	MESQUITE	gr.tot.
		total:	31500	0	0	0	1000	0	0	32500
6/26/86 & 6/29/86	SJN	NAPERBY	26000							
7/3/86	CORNFL	AUSTRALIA					1000			
7/3/86	SJN	MT.BERNST	5500							
			5000?							

Comments:

Mo./Yr.	6/86	7/86	10/86	6/87
	planted trees in bottom of furrows instead of top so they would get water, weather hot & dry, high mortality	replants look good, casuarina look good, replants on west side of field	plantings hit hard by hi Na in soil, rabbit damage, prefer Cas., tree guards installed survival 10-20%,	planting appears to be very marginal, would recommend that more water be applied, grower not available for comment Report in WAY file

SOILS (see file for site description)
Lab Analysis: see BLOESOIL

Mo./Yr.	3/87
Amendments:	-
Fertilizer:	-

IRRIGATION WATER

Quarter	3/87	6/87
Lab Analysis:	-	EC X 1000
		0.6
		for more detail see BLOEWATR
Amount and Frequency:	-	

WATER TABLE
Water Table Depths (feet)

Mo./Yr.	10/28/86	1/20/87	6/87
Well #			
1	7.6	dry	5.3
2	7.9	8.8	5.8
3	8.7	8.6	6.2
4	7.2	8.6	6.8
5	8.1	8.7	6.3
6	8.0	8.9	5.1
7	7.9	8.4	5.3

Analysis of Ground Water
also see BLOEWATR

Quarter	10/28/86		1/15/87		6/87	
	Ec	SAR	Ec X 1000	SAR	Ec X 1000	SAR
Well #						
1	88	210	29	97	45	179
2	63	159	5.6	18	62	221
3	27	87	41	177	32	126
4	47	123	50	156	69	224
5	88	219	0	-	26	111
6	30	77	47	169	68	212
7	71	23	54	188	7	27

TREES

Mo./Yr.	3/87	6/87
Growth:	1 - 3 ft, 10-20% survival	see map in file for ave growth

Lab Analysis:

Wood	-
Leaves	-

WEEDS

Mo./Yr.	3/87
	-

BLOEMHOF AG ENTERPRISES disc: AGROFORESTRY II file: BLOEWATR
last update: 9/17/87

WATER DATA

DATE	WELL #	DEPTH feet	pH	EC x 1000 mmhos	CATIONS meq/l	ALIQUOT mls	VERSINATE mls	Ca + Mg meq/l	Na meq/l	SAR	ESP	TOTAL SALTS meq/l	REMARKS
28-Oct-86	1	7.6		88			6.9	69	1231	210		1300	
	2	7.9		63			6.1	61	879	159		930	
	3	8.7		27			3.2	32	348	87		380	
	4	7.2		47			4.9	49	611	123		660	
	5	8.1		88			6.4	64	1236	219		1300	
	6	8.0		30			4.3	43	357	77		400	
	7	7.9		7.1			1.7	17	66	23		83	
15-Jan-87	1		6.7	29			2.9	29	371	97		400	
	2		6.3	5.6			1.5	15	49	18		64	
	3		6.8	41			2.0	20	560	177		580	
	4		6.6	50			3.6	36	664	156		700	
	5		6.6	0			0.1	1	-	-		-	
	6		7.1	47			2.8	28	632	169		660	
	7		7.3	54			3.0	30	730	188		760	
		pH may be depth reported in wrong row											
22-Jun-87	1	5.3		45		1	2.3	23	607	179		630	
	2	5.8		62		1	3.1	31	869	221		900	
	3	6.2		32		1	2.1	21	409	126		430	
	4	6.8		69		1	3.6	36	949	224		995	
	5	6.3		26		1	1.8	18	332	111		350	
	6	5.1		68		1	4	40	950	212		990	
	7	5.3		7		1	1.3	13	69	27		82	
	canal	n/a		0.6		1	0.25	2.5	4.5	4		7	

BLOEMHOF AG disc: AGROFORESTRY II file: BLOESOIL
last update: 9/17/87

SOIL DATA

DATE	SAMPLE #	DEPTH inches	pH	EC x 1000 mmhos	CATIONS meq/l	VERSINATE mls	Ca + Mg meq/l	Na meq/l	SAR	ESP	TOTAL SALTS meq/l	REMARKS
28-Oct-86	1	3 - 8		37		4.5	45	465	98		510	saline-sodic
	2	3 - 8		5.8		4.6	46	22	4.6		68	saline
	3	3 - 8		28		3.5	35	255	61		380	saline-sodic
	4	3 - 8		24.5		3.4	34	299	73		333	saline-sodic

see map in file for sample locations

SECTION 4.13

Other Farm Reports

Gowen
Meyers
Orton
Rio Vista
Rowan
Stanton
Stratford Public Utility
Tulare Lake Drainage District
Van Groninger

AGROFORESTRY - TREE PLANTING disc: AGROFORESTRY file: AGFOGOWE
last update: 7/7/87

county: FRESNO

farm: GOWEN acreage: 1 av.tr/ac: 1588

PLANTING DATE	NURSERY	SOURCE	EUCA-CAM	EUCA-oth	CAS-GLA	CAS-CUN	CAS-oth	POPLAR	MESQUITE	gr.tot.
		total:	1060	0	0	0	528	0	0	1588
5/28/86	CDF	L.ALBACUT	1060							
5/28/86	CORNFL	AUSTRALIA					528			

Quarter 3/87

Comments: trees look average
aqueduct seepage
seems to keep the
water table high

SOILS

Quarter 3/87

Lab Analysis: -

Amendments: none

Fertilizer: none

IRRIGATION WATER

Quarter

Lab Analysis: good quality
Westlands water

Amounts & Frequency: ~1 ft during 1986
after planting

WATER TABLE

Quarter 3/87

Depth: 24 inches

Lab Analysis: Ec = 2 to 3
prior to planting

TREES

Quarter 3/87

Growth: -

Lab Analysis:

wood -

leaves -

WEEDS Quarter 3/87

chemical sprays &
hand weeding
adequate

AGROFORESTRY - TREE PLANTING disc: AGROFORESTRY file: AGFOMEYE
last update: 9/24/87

county: FRESNO

farm: MEYERS acreage: 28 av.tr/ac: 1371

PLANTING DATE	NURSERY	SOURCE	EUCA-CAM	EUCA-oth	CAS-CUN	CAS-oth	POPLAR	MESQUITE	ELDERICA PINE	gr.tot.
		total:	38000	0	0	0	0	0	400	38400
8/20/87	CDF	L.ALBACUT	20000							
8/20/87	SJF	L.ALBACUT	18000							
8/20/87		MONDEL PINE							400	

Comments: Mo./Yr. 9/87
planted for erosion control, west of I-5 on sloping ground, spacing 6.5'X 5'

SOILS

Lab Analysis:
Amendments:
Fertilizer:

IRRIGATION WATER

Lab Analysis:

Amounts &
Frequency:

WATER TABLE

Depth:

Lab Analysis:

TREES

Growth:
Lab Analysis:
wood
leaves

WEEDS

AGROFORESTRY - TREE PLANTING disc: AGROFORESTRY file: AGFOORTO
last update: 9/25/87

county: KINGS

farm: ORTON acreage: 4 av.tr/ac: 1500

PLANTING DATE	NURSERY	SOURCE	EUCA-CAM	EUCA-oth	CAS-CUN	CAS-oth	POPLAR	MESQUITE	ELDERICA PINE	gr.tot.
		total:	6000	0	0	0	0	0	0	6000
7/8/87	CDF		6000							

Comments: Mo./Yr. 9/87

SOILS

Lab Analysis:
Amendments:
Fertilizer:

IRRIGATION WATER

Lab Analysis:

Amounts &
Frequency:

WATER TABLE

Depth:

Lab Analysis:

TREES

Growth:
Lab Analysis:
wood
leaves

WEEDS

AGROFORESTRY - TREE PLANTING disc: AGROFORESTRY file: AGFORIOV
last update: 9/30/87

county: KINGS

farm: RIO VISTA acreage: 1.19 av.tr/ac: 378

PLANTING DATE	NURSERY	SOURCE	EUCA-CAM	EUCA-oth	CAS-CUN	CAS-oth	POPLAR	MESQUITE	ELDERICA PINE	gr.tot.
		total:	450	0	0	0	0	0	0	450
8/4/87	CDF	L.ALBACUTYA	450							

Comments: Mo./Yr. 9/87
spaced 6'X 8',
2 rows, 2600' long?
planted as an inter-
ceptor

SOILS
Lab Analysis:
Amendments:
Fertilizer:

IRRIGATION WATER
Lab Analysis:

Amounts &
Frequency:

WATER TABLE
Depth:

Lab Analysis:

TREES
Growth:

Lab Analysis:
wood
leaves

WEEDS

AGROFORESTRY - TREE PLANTING disc: AGROFORESTRY file: AGFOROWA
last update: 9/30/87

county: KINGS

farm: ROWAN acreage: 2 av.tr/ac: 1816

PLANTING DATE	NURSERY	SOURCE	EUCA-CAM	EUCA-oth	CAS-CUN	CAS-oth	POPLAR	MESQUITE	ELDERICA PINE	gr.tot.
		total:	3631	0	0	0	0	0	0	3631
'87	SJN	L.ALBACUTYA	3631							

Comments: Mo./Yr. 9/87
'87 planting info
incomplete, spacing
4'X 5', 5 plantings?

	#rows	#trees
#1	29	1,089
#2	23	726
#3	32	908
#4	22	545
#5	22	363

SOILS
Lab Analysis:
Amendments:
Fertilizer:

IRRIGATION WATER
Lab Analysis:

Amounts &
Frequency:

WATER TABLE
Depth:

Lab Analysis:

TREES
Growth:
Lab Analysis:
wood
leaves

WEEDS

AGROFORESTRY - TREE PLANTING disc: AGROFORESTRY file: AGFOSTAN
last update: 9/25/87

county: KINGS

farm: STANTON acreage: 2 av.tr/ac: 1500

PLANTING DATE	NURSERY	SOURCE	EUCA-CAM	EUCA-oth	CAS-CUN	CAS-oth	POPLAR	MESQUITE	ELDERICA PINE	gr.tot.
		total:	3000	0	0	0	0	0	0	3000
7/14/87	CDF		3000							

Comments: Mo./Yr. 9/87

SOILS

Lab Analysis:
Amendments:
Fertilizer:

IRRIGATION WATER

Lab Analysis:

Amounts &
Frequency:

WATER TABLE

Depth:

Lab Analysis:

TREES

Growth:
Lab Analysis:
wood
leaves

WEEDS

AGROFORESTRY - TREE PLANTING disc: AGROFORESTRY file: AGFOSTRA
last update: 9/30/87

county: KINGS

farm: STRATFORD PUBLIC UTILITY acreage: 7 av.tr/ac: 1600

PLANTING DATE	NURSERY	SOURCE	EUCA-CAM	EUCA-oth	CAS-CUN	CAS-oth	POPLAR	MESQUITE	ELDERICA PINE	gr.tot.
		total:	11200	0	0	0	0	0	0	11200
9/10/87	CDF	L.ALBACUTYA	11200							

Comments: Mo./Yr. 9/87
ave. spaced 4.5'X 6'
in 112 rows
4 rows w/ more
gypsum?(note)

SOILS

Lab Analysis:
Amendments:
Fertilizer:

IRRIGATION WATER

Lab Analysis:

Amounts &
Frequency:

WATER TABLE

Depth:

Lab Analysis:

TREES

Growth:
Lab Analysis:
wood
leaves

WEEDS

AGROFORESTRY - TREE PLANTING disc: AGROFORESTRY file: AGFOTULA
last update: 9/30/87

county: KINGS

farm: TULARE LAKE DRAINAGE DISTRICT acreage: 3.4 av.tr/ac: 794

PLANTING DATE	NURSERY	SOURCE	EUCA-CAM	EUCA-oth	CAS-CUN	CAS-oth	POPLAR	MESQUITE	ELDERICA PINE	gr.tot.
		total:	2100	400	0	200	0	0	0	2700
5/1/87	CDF	L.ALBACUTYA	2000							
5/1/87	CORNFLOWER	C. glauca				200				
5/1/87	SJF	MT BERNSTEAD	100							
5/1/87	FOOTE	FOOTSEI		400						

Comments: Mo./Yr. 9/87
for '87 planting all spaced 5'X 6', CDF in 25 rows on 3 ac, Cas 3 rows on 0.15 ac, Bern in 2 rows on .05 ac, Foote in 4 rows on .20 ac
Showing stress?

SOILS
Lab Analysis:
Amendments:
Fertilizer:

IRRIGATION WATER
Lab Analysis:

Amounts &
Frequency:

WATER TABLE
Depth:

Lab Analysis:

TREES
Growth:

Lab Analysis:
wood
leaves

WEEDS

AGROFORESTRY - TREE PLANTING

disc: AGROFORESTRY file: AGFOVANG
last update: 9/30/87

county: KINGS

farm: VAN GRONINGER acreage: 0.04 av.tr/ac: 1750

PLANTING DATE	NURSERY	SOURCE	EUCA-CAM	EUCA-oth	CAS-CUN	CAS-oth	POPLAR	MESQUITE	ELDERICA PINE	gr.tot.
		total:	70	0	0	0	0	0	0	70
7/18/87	CDF	L.ALBACUTYA	70							

Comments: Mo./Yr. 9/87
spaced 4'X 6'
in 10 rows

SOILS

Lab Analysis:
Amendments:
Fertilizer:

IRRIGATION WATER

Lab Analysis:

Amounts &
Frequency:

WATER TABLE

Depth:

Lab Analysis:

TREES

Growth:
Lab Analysis:
wood
leaves

WEEDS

SECTION 5.0

Tree Selection and Propagation Project

Roy Woodward, Roy Sachs and Miles Merwin (ITCI)
Department of Environmental Horticulture
University of California, Davis

Propagation of Salt Tolerant *Eucalyptus* and *Casuarina*

Progress Report
August 1987

Roy Woodward, Roy Sachs and Miles Merwin
Department of Environmental Horticulture
University of California, Davis

INTRODUCTION

For many years certain tree species in Israel, China, and Australia have been grown with saline irrigation water. An agroforestry plantation on a saline site irrigated with saline water can improve the quality of the land, the quality of subsequent drainage water, and provide important forest biomass on sites that would otherwise be unproductive.

Plantations of hardwood tree species established in California in the past few years have exhibited great variation in survival, growth, and tree form when grown under saline conditions. Selection and clonal propagation of outstanding individual trees from existing plantations will provide a source of trees with known performance for use in future plantations in the San Joaquin Valley.

PROGRESS TO DATE

Selections of superior *Eucalyptus camaldulensis* (Red Gum), *Casuarina glauca* and *Casuarina cunninghamiana* (Beefwood) were made at Murrieta Farms and at the Peck Ranch in Fresno County. Trees were selected on the basis of height, basal diameter, form (straightness and unforked trunk), and general appearance of good health with a requirement that the plantation be two-years-old and have undergone irrigation with saline water. 20 *E. camaldulensis*, 9 *C. cunninghamiana*, and 2 *C. glauca* were selected at Murrieta Farms, and 14 *E. camaldulensis* and 4 *C. cunninghamiana* were selected at the Peck Ranch.

The selected trees were labelled and cut-off at the base in February 1987 leaving a 15 cm tall stump. These trees were revisited in April 1987 and stump sprouts were removed from 22 of the *E. camaldulensis*. None of the *Casuarina* had sprouted sufficiently to provide cuttings at this time. These cuttings were taken to UCD and rooted in heated mist benches. After rooting, the trees were replanted in indivdual containers and maintained in greenhouses at UCD from which subsequent cuttings can be taken. About 250 trees were successfully rooted from these initial cuttings.

The field sites were revisited in August 1987 and cuttings collected from 21 *E. camaldulensis*. These cuttings are now in the rooting benches at UCD and should provide an additional 500 rooted

cuttings. The authors would like to thank Lu Lohr (UCD Department of Agricultural Economics) for her help with the field collections in April and August.

As stated above, none of the sprouts of *Casuarina* were big enough for cutting in April, but cuttings were collected from 4 large, uncut *C. glauca* and 4 *C. cunninghamiana* adjacent to the cut stumps. An attempt to root these cuttings produced only 8 rooted *C. glauca*. Collections of *Casuarina* were made in August from cut stumps at Peck Ranch, but none of the stumps at Murrieta Farms had sprouted adequately to provide cuttings, and in fact many of the stumps had apparently died. It is expected that about 100 rooted trees will be obtained from the cuttings collected in August.

Some of the originally selected*Eucalyptus* were not relocated during subsequent visits. The denseness of the stands and the weed situation (at Peck Ranch the weeds are over 2 m tall and form a solid wall throughout the plantation) made finding the cut stumps very difficult. Other trees have proven to have poor rooting properties and will not be used in subsequent tests.

In general, cutting of select trees for production of sprouts that can be used to obtain rooted cuttings has been a success. There seems to be a correlation between the apparent health of a tree in the field and the ability of the tree to root; healthier trees root faster and more prolifically.

The goal of making rooted cuttings was to obtain 3,000 trees for field planting in spring 1988. This goal will be achieved in the following ways; 1) one additional visit to the field sites will be made in October 1987 to collect stump sprouts, 2) additional cuttings will be derived from previously rooted trees at UCD, 3) seedling trees will be started at UCD from selected salt-tolerant seed from Australia and Israel, 4) rooted cuttings will be made of other select *E. camaldulensis* found to have exceptional growth at non-saline sites, such as the C-2 'Dale Chapman' clone.

Samples of rooted trees will undergo salinity screening in the laboratory at UCD. Trees in containers will be watered with increasing levels of saline solutions and the survival/growth of each tree monitored. Additional tree sections will be placed in the Scanning Calorimeter and subjected to increasing saline conditions and the temperature of metabolism measured with increasing stress. Sufficient rooted material now exists for these tests to commence in September 1987. We feel that the performance (survival and growth charicteristics) of the cloned material in plantations grown under

saline conditions can be correlated with the laboratory measurements to provide a means of screening future populations of trees prior to outplanting on saline sites.

Selections of the salt tolerant trees will also be included in cold tolerance screening that is now being conducted at UCD. We have obtained a growth chamber (in cooperation with the California Department of Forestry and Fire Protection) with which the temperature and lighting environment of containerized trees can be controlled over extended periods of time. Using this chamber the trees can be subjected to freezing conditions simulating cold-season events in the San Joaquin Valley. Trees not showing a capability of withstanding winter conditions will be eliminated from future use.

FUTURE RESEARCH

During the next six months additional trees will be selected from saline sites in the San Joaquin Valley. Because of the previously successful work of CDFA, many plantations will be two years old this next year and the number of trees available to make selections will increase tremendously. These trees will be prepared to obtain cuttings in the spring-summer of 1988.

Rooted cuttings from existing field grown trees and those selected in the future will be used to continue the screening process for saline and cold tolerance in the laboratory. It is important that the growth charicteristics of the trees be evaluated in the laboratory in order to operate an economical and successful rooted cutting program.

Micropropagation and clonal *in vitro* methods will be attempted with selected trees to increase the reliability and speed with which superior trees can be obtained for field planting. The efficacy of establishing seed plantations in California will also become more apparent as a result of this work.

The 3,000 rooted cuttings and seedlings will be planted in spring 1988 in an experiment to assess the practicality of using hardwood species for saline water management. Survival and growth measurements of these field planted trees will be important in determining the future direction of superior tree selection, laboratory screening procedures, salt-balance experiments, and bio-filter research.

SECTION 6.0

Economic and Marketing Study

Luanne Lohr
Department of Agricultural Economics
University of California, Davis

QUARTERLY REPORT ON AGROFORESTRY PROJECT - ECONOMICS

Luanne Lohr - University of California, Davis

August 31, 1987

I. INTRODUCTION

The economic analysis of the California Department of Food and Agriculture's (CDFA) agroforestry project was begun in April 1987. The primary objectives during the first five months have been to 1) develop theoretical models for the biological and economic aspects of tree growth and 2) to collect data for estimating these models.

~~An overview of the economic project is given by the flow chart in Figure 1.~~ There are three phases of analysis: 1) the tree production function, 2) the net present value model of tree farming, and 3) the comparison of returns from conventional crops and trees. ~~Necessary functional and data inputs are listed at each step.~~ Collection of data for all phases is taking place simultaneously, in order to maintain as much consistency as possible across models, and to identify data deficiencies early in the project.

Each of the three phases is explained in the following sections. Progress toward completing each part is also described, along with plans for further work.

II. TREE PRODUCTION FUNCTION

In this phase, we will be developing a model for predicting the growth of short rotation trees species under differing climatological, site, and treatment conditions. Previous models of tree growth in California are not site-specific and are not based on cultural techniques which are being employed in the San Joaquin Valley (SJV).

Thus, they do not capture the variability across sites on which short rotation trees are or may be grown, including important factors like salinity.

Additionally, models such as that developed by the University of California Cooperative Extension in Forestry (UC Coop Extension), are based on a forestry concepts requiring previous growth information. For areas where tree farming is not now practiced, the index (low, medium, and high) must be guessed.

For this project, we are collecting climatological data for experimental and commercial sites for which data on growth and treatments for several species are available. Using regression techniques, we will determine the influence of these factors on growth of short rotation species. The regression results can be used to predict future growth for various regions in California. The equation may be used to provide farm-specific estimates of expected yield for farmers who are considering planting trees.

Data has been collected from experimental plots at UC Riverside, UC Davis, and the UC Sierra Agricultural Field Station, from growers in the SJV project, and from published sources on other experimental and commercial stands. Site characteristics such as soil type and use limitations and climatological data from the National Oceanic and Atmospheric Administration (NOAA) such as precipitation and temperature readings have also been collected. This data set is being used to estimation a regression relationship for growth.

The growth function determined can be used to generate yield per acre under differing conditions. Yield is related to growth by tree height and diameter at breast height measurements, as well as by

percentage moisture. Yield functions will be determined from the literature and from discussions with UC Coop Extension and UC Environmental Horticulture personnel.

The results obtained from this portion of the project will be verified in four ways. First, predictions from this model will be compared with simulation results of the UC Coop Extension model and of standard theoretical models in the forestry literature. Development of models to use for comparison are proceeding now.

Second, more data will be collected from a statewide agroforestry inventory and production cost survey. A screening questionnaire is being prepared to determine where existing stands of Eucalyptus and Casuarina are located. Suitable respondents for a more detailed cost of production survey will be identified through this process.

The results of this survey will be used to verify both the growth model and the net present value models discussed below. The advantages of this data are that it will represent a larger cross-section of sites where agroforestry may be practiced, and it will provide information about different-aged trees. The inventory of current trees will help in the assessment of potential market demand for short rotation trees. Both the screening questionnaire and the detailed survey are being prepared for mailing now.

Third, we will continue to obtain growth data directly from CDFA from the agroforestry project as it becomes available. This data may be used both to update the data set for the model and to verify directly the predictions of the growth curve.

Finally, we will submit the estimated model and its predictions to experts in the area for their review. Comments by these specialists

will be taken into account in the final design of the growth function and subsequent production model.

III. NET PRESENT VALUE OF TREE FARMING

We will assess the net present value of tree farming during this phase of the project. A theoretical mathematical optimization model has been constructed which includes cost functions for planting, growing, harvesting, and transporting short rotation trees. Empirical data for estimating these functions will come from the results of the SJV agroforestry survey and the statewide cost of production survey. The advantage of this data is that it represents costs due to actual production practices, which may not necessarily represent ideal, least cost techniques.

Engineering data on costs is also being collected to verify the empirical data and to fill gaps in information about least cost practices. This data is being obtained from CDFA and UC Coop Extension.

Prices and transportation costs depend on which end use is selected for the trees. Existing end uses include chips for pulping, chips for cogeneration, and cordwood for residential use. Potential uses include chips for export, use as a chemical feedstock, and ethanol production. The location of the buyers and the price they currently pay for wood or for substitutes will determine the transportation costs and prices they can afford for SJV wood products. An additional factor is the amount of short rotation trees currently being grown in California and their market availability.

Location data is being collected from listings and maps of current and potential users of short rotation trees. Prices are being obtained by telephone contact with these consumers and from published sources.

UC Coop Extension is surveying cogenerators about the amounts of wood and prices paid for them. They have agreed to share this data with us when the survey is completed.

Other benefits to tree farming in the SJV will be assessed as information on them becomes available. Possibilities for other revenue include honey production and the selling of private hunting permits.

Linear or quadratic programming will most likely be used to determine the optimal economic rotation of the tree stands. This may or may not match recommendations currently being made on the basis of physical maturity, but should enable farm-specific planning to maximize returns. Dynamic programming will probably be used to determine these returns once the optimal rotation period is known. The specification of these models and the coding of them for computer analysis is underway.

IV. OPTIMAL MIX OF CONVENTIONAL CROPS AND TREE FARMING

Growing trees in the SJV may serve two purposes. First, tree farming may be an additional source of revenue for farmers, given the relatively high salt tolerance of several species. They may be planted in fields as crops are and given special treatment which will maximize their growth.

A second, and more environmentally crucial use is as a partial solution to drainage and salinity problems in the area. Short rotation trees may be able to lower water tables, intercept lateral runoff flows, and serve as disposal sites for tile drainage water. These benefits may be measured by the costs of projects such as evaporation ponds which would be reduced or eliminated due to growing trees. These avoided costs will be included in the final analysis of the best mix of trees and crops.

For this phase, data is being collected on prices and costs associated with growing conventional crops in the SJV. Also, engineering estimates of the costs of projects necessary to control salinity and drainage problems will be obtained.

A mathematical optimization model will be used to determine the best mix of trees and crops under particular technical and financial constraints faced by farmers. The development of this model and the relevant constraints is proceeding. Estimation will take place when all necessary data and functional inputs have been obtained.

SECTON 7.0

Wildlife Study

Andrew R. Dyer and David L. Chesemore
Department of Biology
California State University, Fresno

A G R O F O R E S T R Y P R O J E C T

The Use of Cultivated, Salt-Tolerant Vegetation by Wildlife- I

Quarterly Report Number 1

By: Andrew R. Dyer and David L. Chesemore

Department of Biology
California State University, Fresno
Fresno, California 93740-0073
(209) 294- 2010 or 2001

Submitted to: Dr. Vashek Cervinka

California Department of Food and Agriculture
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15 September 1987

SUMMARY OF ACTIVITIES

June-August, 1987

The following pages summarize much of the data collected during the period June-August, 1987. There is more data that has yet to be fully analyzed and which will be reported later. This report contains survey information on the species of mammals, birds, herpetofauna and herbaceous vegetation found to date in the six study sites of the Agroforestry Project. Additionally, some analysis of this preliminary data has also been offered.

The 3 months of the project so far have been spent collecting as much base information as possible and has focused primarily on identification of species and measurement of trees. The point quarter method of measuring tree size and density was used for all sites, 50 points per site, and that information is being studied. Clip plot and line intercept methods were also used to quantify species' cover and diversity and to make early estimates of biomass and are included here.

Mammal trapping methods were employed using Sherman Live traps on established trapping grids for each site. Trap success and species information is summarized here for approximately 2000 trap nights. Additional survey trap lines are not discussed, but any new species recorded are included on the species lists. Trapping data was gathered on 8 by 8 trapping grids with bird seed used as bait.

Recapture methods were employed with success, but data will be reported after more information has been gathered. Each site was trapped for 5 nights simultaneously with 3 or more of the other sites for a total of about 300 trap nights per site.

Bird observations and counts were made at set stations for 6 minute intervals. A total of 10 sets of 6 minute observation intervals were recorded for each site. The information is summarized in the bird list.

Information regarding the herpetofauna of the sites was gathered on a general survey basis. At this point it can be stated that numbers and diversity of herpetofauna are extremely low with few exceptions. Data will be gathered coincidently with that for other animal groups for the duration of the project.

The information presented here reflects much of the activity of the summer months. Later reports will include data on scent stations, permanent marked-recapture of rodents, owl pellet analysis, home range size and foraging patterns of certain rodents, and nesting success of birds. Additionally, multiple regression analysis of tree growth rates will be summarized for the 6 sites.

The Allen site is a 5 acre plot approximately 100 feet wide and half a mile long. The trees are arranged in 11 rows of Eucalyptus at the south end and widening to 14 rows at the northern end. A single row of Casuarina border the western side. The site is bordered on the east side by an irrigation canal that continuously holds water; a small drainage canal borders on the north and only occasionally holds water. Opposite the northeast corner is a row of Tamarisk trees of undetermined age that shelters large numbers of roosting and nesting birds as well as mammals such as the coyote. The row of trees is about 50 m. long and 10 m. wide.

The site is actively managed; ground cover is very low (<1%). The trees have also been pruned .3-.5 m. off the ground. The trash from the pruning has been left on the site.

The site has proven to have a very dense population of rodents, particularly the Deer Mouse, Peromyscus maniculatus. There are numbers of pocket gophers (Thomomys bottae) as well although so far they are known solely from evidence of burrowing. A large number of birds have been sighted at the site although most were flying overhead in the direction of the Mendota Wildlife Refuge. Nesting has not been noted in the trees, but a large number of nests have been found in the Tamarisk row to the northeast. That corner of the plot is a very active area for birds.

MURIETTA RANCH

The Murietta Ranch site is the largest of the six sites and one of the most diverse in a number of ways. The two-year-old section (north side) is comprised of 3 rows of Poplars, 3 rows of Casuarina of 2 species and 7 rows of Eucalyptus. Very few of the Poplars survived to the second year; the Casuarina and Eucalyptus however have reached heights of 7 m. The ground cover in this area (Section 4) is about 2% with very low diversity. The rodents to date are exclusively Peromyscus maniculatus and are present in large numbers although accurate density levels are not yet available. This section is bounded on the north side by bare ground and a small drainage canal, normally dry.

The one-year-old trees have been divided into 3 sections for sampling purposes because the percentage of ground cover and the size of the trees was highly variable. It is difficult to accurately measure the density of herbaceous plants and ground cover because of the weed control activities taking place on the site, but it was felt at the time of sampling that stratification of the site was justified. This may not be true in the future, especially as the Eucalyptus canopy begins to close. Section 1 is the main body of one year old trees and is distinguished by moderate ground cover (25%) and a generally smaller size for the trees. Section 2 is a strip along the southeastern side approximately 100 m. long by 30 m. wide with ground cover estimated at 60%. Section 3 is the southeast corner. Earlier in the year

samples were taken. The trees are appreciably larger than those of similar age in other parts of the site. Additionally, Section 3 has much higher densities of Morning Glory, Convolvulus arvensis, and Curly Dock, Rumex crispus, than other areas.

The younger sections are comprised of 3 rows of Casuarina immediately adjacent to the older trees of the site and 68 rows of Eucalyptus to the south. In addition to a large population of Peromyscus, this site has also yielded two species of Muridae: the house mouse (Mus musculus) and the black rat (Rattus rattus). There does not seem to be large numbers of these two however.

Nesting has been observed in the two year old Casuarina on several occasions. Nests discovered in June and July appeared to belong to House Finches (Carpodacus mexicanus) and Blackbirds (Euphagus cyanocephalus and Agelaius phoeniceus californicus), however no successful fledging was observed. In August, Mourning Dove nests were found with eggs and half-grown young. To this point, no nesting has been observed in the Eucalyptus regardless of age on this site. Abandoned nests found around the Casuarina appeared to have been victimized by predators and/or windthrow. There are also birds nesting around the site and making use of the trees. In particular, Western Kingbirds (Tyrannis verticalis), Barn Swallows (Hirundo rustica) and Killdeer (Charadrius vociferus) have been observed. Other water birds use the freshwater pond, but no nesting activity has been observed. However, the ranch foreman has informed the investigators that a Green-winged Teal (Anas carolinensis) successfully raised a brood in the spring of 1987.

WAKEFIELD RANCH

The Wakefield Ranch site is considered to be a control site of sorts. Although it has a different composition and history, no runoff water is being applied. This site is about 1.5 h. in size and contains trees of varying ages; a range from 2 to 4 years with additional trees added at the discretion of the owner. The tree and weed sampling techniques were done with this in mind and the data are divided into three sections.

For this site, rodent levels are very low in comparison to other sites. The reasons for that are not immediately clear, but it may be tied to the drip irrigation practices now in place. Vegetative cover is very low except in the younger trees and plant diversity is correspondingly reduced.

Because of the age and height of the trees (10-12 m. at 4 years) large numbers of birds are active in the site. Diversity is not as high as other sites however. More nesting and roosting has been observed at Wakefield than elsewhere, especially for the Mourning Dove. Some migrants, such as the Western Tanager (Piranga ludoviciana) have also been making use of the cover offered by this site. Predatory birds, notably the Barn Owl (Tyto alba) and the Kestrel (Falco sparverius) use the older trees for roosting. There are a number of other nests and pieces of evidence that have not yet been identified or linked to a particual species. Additionally, because the amount of cover offered by the large trees hinders identification of some species of smaller birds; the list of birds for Wakefield is incomplete.

PECK RANCH

The Peck site is situated approximately 3.5 k. south and east of the Wakefield site. Peck is unique in several ways. It is located adjacent to some 10 h. of evaporation ponds that have had a marked influence on the character of the site. Water for the site has been pumped directed from the ponds to the trees. Additionally, no weed management practices are in effect and the herbaceous species are dominating the site.

Peck is 3.3 h. of one year old trees in approximately a square shape. There are 9 rows of Casuarina trees on the eastern edge that are generally very healthy. The rest of the site is composed of Eucalyptus of various sizes and heights. Although, weed species grow unchecked, the diversity of plantlife is low. Only three or four species are responsible for 99% of the cover; Mare's Tail, Conyza canadensis, Morning Glory, Convolvulus arvensis and Sunflower, Helianthus annuus. Of the three, C. canadensis makes up about 95% of the total.

The Eucalyptus trees of Peck appear to be struggling for survival. Many of the trees are yellowish rather than the dark green more common in other sites. This could be due to the high water table or to the quality of water used for irrigation. No irrigation has taken place since late May, 1987, yet the trees and weeds show no signs of water stress. This leads to the conclusion that the water table must be high enough to be accessed by the vegetation on the

site. Loss of individual trees can be traced to several causes. Several small trees were found either stripped of bark near the ground or with the roots or base gnawed through by rodents. Many smaller trees were found completely covered and pulled down by the weed species as well. C. arvensis commonly pulls the small trees down.

The degree to which the ground is covered and protected may account for the numbers and diversity of rodents found at Peck. To date Peromyscus maniculatus and the California Vole, Microtis californicus have been caught steadily and in large numbers.

As with Wakefield, the vegetation at Peck offers considerable cover and bird identification is often hampered. A number of species have been included on the Peck bird list due to being observed in and around the evaporation ponds to the north.

The Thompson site is about 24 k. to the south and east of the Peck site and is similar in size and composition to the Allen site. The site is not as long as Allen, but is somewhat wider, the total being 2.4 h. The single row of Casuarina is found on the western edge. On the eastern edge for two thirds of the length from the south is a large holding ditch for runoff water similar to the one at Allen. An uncultivated field with uncontrolled weed species is located to the east of the northern half of the site. The side open to the fields, the western side, was on the edge of a tomato field through August.

Thompson is not irrigated regularly. The trees facing west are not as tall and robust as the rows farther in. Due to the heat and dryness of the summer many trees were observed in August bending down and with burnt and dried leaves.

Lack of irrigation water may also account for the sparse ground cover and low weed diversity at Thompson. Rodent captures were relatively low, about 40% of the capture rate found at Allen. Bird numbers and diversity were also reduced at this particular site. The only nest observed was a Western Kingbird on a telephone pole adjacent to the site.

HAYNES RANCH

The Haynes Ranch site is located about 56 k. south of Fresno on Highway 41 in Kings County. The area is very different than that of the other five sites. As a consequence, the species composition is significantly different at every level. The site was formerly alkali scrub and is still surrounded by that type of vegetation. The soil is powdery and extremely saline. The trees are located immediately adjacent to the highway and on either side of a small irrigation canal carrying water from the Kings River. It is difficult to quantify the present dimensions of the site for a number of reasons. The site is split and the trees on either side of the canal are experiencing different growth patterns. The trees on the eastern side suffered high losses early on and it is now difficult to locate entire rows of trees. On the western side, the trees seemed to survive the initial planting, but have suffered from rodent depredation and water stress since then. An area of mesquite was included originally, but none of the trees are now more then a few inches in height. The site is too small to easily stratify for sampling, but there is also very little uniformity.

The weed species found at Haynes include species from other sites as well as a number found no where else. The species run the gamut from saltgrass (Distichlis) and spikeweed (Hemizonia) to wet species such as bulrushes (Scirpus). The eastern side tends to be drier and with more species found in arid conditions while the western side is dominated by grasses and Five Hook Bassia, Bassia

any of the sites.

The rodents in the area are also diverse, but somewhat peculiar. There are high numbers of Peromyscus and Dipodomys surrounding the site in the outlying vegetation, but the traps within the site were dominated by a single species, Mus musculus.

The birds numbers and diversity were also high. A number of species, such as Forster's Tern (Sterna forsteri) and the Western Bluebird (Sialia mexicana) indicate that Haynes may be in the path of travel for some species. A mating pair of Blue Grosbeaks (Guiraca caerulea) successfully fledged at least one young on the western side of the sight. The species is not common to that area.

The Haynes site also yielded a reptile, the Side-Blotched Lizard, Uta stansburiana, which is abundant around the site and makes some use of the margins.

Mammal List

Common Name	Family	Scientific Name	A	M	W	P	T	H
RODENTIA								
Deer Mouse	Cricetidae	Peromyscus maniculatus	X	X	X	X	X	
S. Grasshopper Mouse	"	Onychomys torridus				X	X	
W. Harvest Mouse	"	Reithrodontomys megalotis		U		U		X
California Vole	"	Microtis californicus				X		
Heermann's Kangaroo Rat	Heteromyidae	Dipodomys heermanni						A
Valley Pocket Gopher	Geomyidae	Thomomys bottae	E			E		E
House Mouse	Muridae	Mus musculus		X				X
Black Rat	"	Rattus rattus		X				
LAGOMORPHA								
Blacktailed Jackrabbit	Leporidae	Lepus californicus	X	X				X
Desert Cottontail	"	Sylvilagus auduboni			X	X		X
CARNIVORA								
Coyote	Canidae	Canis latrans	E		E	E		E
Domestic Cat	Felidae	Felis domesticus						E

Reptile List

Common Name	Family	Scientific Name	A	M	W	P	T	H
SQUAMATA								
Side blotched Lizard	Iguanidae	Uta stansburiana						X
Gopher Snake	Colubridae	Pituophis melanoleucus						U

Amphibian List

Common Name	Family	Scientific Name	A	M	W	P	T	H
SALIENTIA								
Bullfrog	Ranidae	Rana catesbiana	A	A				A
Western Toad	Bufonidae	Bufo boreas	X		X		X	X

X= confirmed sighting or capture on the site
A= confirmed sighting or capture around the site
E= evidence of presence, i.e. prints, scat or burrows
U= unconfirmed sighting

BIRD SIGHTING LIST

Common Name	Family	Scientific Name	A	M	W	F	T	H
Great Blue Heron	Ardeidae	Ardea herodias	O			A		O
Cattle Egret	"	Bubulcus ibis	(O)	A				A
Great Egret	"	Casmerodius albus	O	O				O
Snowy Egret	"	Leucophoyx thula	O	O				
Mallard	Anatinae	Anas platyrhynchos	I			O		
Green-winged Teal	"	Anas carolinensis		(I)				
Turkey Vulture	Cathartidae	Cathartes aura		A				
Black-Shouldered Kite	Elaninae	Elanus leucurus	O	I		I	O	
Sharp-Shinned Hawk	Accipitrinae	Accipiter striatus	A	A				
Red-tailed Hawk	Buteoninae	Buteo jamaicensis	A	A		A		A
Marsh Hawk	Circinae	Circus cyaneus		I			O	A
American Kestrel	Falconinae	Falco sparverius	A	A	I	A		
Ringnecked Pheasant	Phasianidae	Phasianus colchicus	I					
American Coot	Rallidae	Fulica americana				A		
Killdeer	Charadriidae	Charadrius vociferus	A	I			A	A
Long-billed Curlew	Scolopacidae	Numenius americanus	O	O	A	A	O	
Greater Yellowlegs	"	Totanus flavipes		A				
Least Sandpiper	"	Erolia minutilla		A				
American Avocet	Recurvirostridae	Recurvirostra americana		A		A		
Black-necked Stilt	"	Himantopus mexicanus	A	A		A		
California Gull	Larinae	Larus californicus	O			A		O
Forster's Tern	Sterninae	Sterna forsteri						O
Caspian Tern	"	Hydroprogni caspia				A		
Rock Dove (Pigeon)	Columbidae	Columba livia	O					
Mourning Dove	"	Zenaidura macroura	I	I	I	O	I	I
Barn Owl	Strigidae	Tyto alba			I	I		2
Great Horned Owl	"	Bubo virginianus			E			A
Long-eared Owl	"	Asio otus	E					

I= Observed perching or feeding on the site
O= Observed flying over the site
A= Seen adjacent to or in the vicinity of the site
E= Evidence of presence, i.e. pellets, nest
2= Remains found on site
()= Unconfirmed sighting

A G R O F O R E S T R Y P R O J E C T

BIRD SIGHTING LIST

Common Name	Family	Scientific Name	A	M	W	P	T	H
Lesser Nighthawk	Caprimulgidae	Chordeiles acutipennis		O				A
Hummingbirds	Trochilidae	(species not known)	I		I	I	I	
Western Kingbird	Tyrannidae	Tyrannis verticalis	I	I	I		I	I
Say's Phoebe	"	Sayornis saya		I			I	
Horned Lark	Alaudidae	Eremophila alpestris	A	A			A	
Bank Swallow	Hirundinidae	Riparia riparia	O	O	O	O	O	O
Barn Swallow	"	Hirundo rustica	O	O	(O)		O	O
Common Crow	Corvidae	Corvus brachyrhynchos	A	A	I			
Mockingbird	Mimidae	Mimus polyglottos	A	I	I		I	I
American Robin	Turdidae	Turdus migratorius			I			A
Western Bluebird	"	Sialia mexicana						I
Loggerhead Shrike	Laniidae	Lanius ludovicianus	A		A	I	I	I
European Starling	Sturnidae	Sturnus vulgaris	A	I				
House Sparrow	Ploceidae	Passer domesticus	A	A		O	I	I
Western Meadowlark	Icteridae	Sturnella neglecta	A			I		I
Yellowheaded Blackbird	"	Xanthocephalus xanthocephalus				A		
Bicolor Blackbird	"	Agelaius phoeniceus cal.	I	I	I	I	I	A
Bullock's Oriole	"	Icterus bullockii						I
Brewer's Blackbird	"	Euphagus cyanocephalus	I	I	I	I	I	I
Western Tanager	Thraupidae	Piranga ludoviciana			2			
Blue Grosbeak	Fringillidae	Guiraca caerulea						I
Evening Grosbeak	"	Hesperiphona vespertina					I	
House Finch	"	Carpodacus mexicanus	I	I	I	I	I	I
Black Rosy Finch	"	Leucosticte atrata						(I
Chipping Sparrow	"	Spizella passerina	A					
Harris' Sparrow	"	Zonotrichia querula						I
White-Crowned Sparrow	"	Zonotrichia leucophrys					(I)	
Song Sparrow	"	Melospiza melodia	I	I	I	I	I	

56 species

	A	M	W	P	T	H
Confirmed-	29	31	14	22	16	25
Unconfirmed-	2	1	4		3	2

I= Observed perching or feeding on the site
O= Observed flying over the site
A= Seen adjacent to or in the vicinity of the site
E= Evidence of presence, i.e. pellets, nest
2= Remains found on site
()= Unconfirmed sighting

Site Diversity

Site	# Hectares	# Mammals	# Birds	# Herps	# Plants
Allen	2.0	4	29-2	2	29
Murietta	9.4	5	31-1	1	33
Wakefield	1.6	3	14-4	1	11
Peck	3.3	7	22	0	20
Thompson	2.4	2	16-3	1	22
Haynes	2.1	8	25-2	3	29

Table 1.1- A listing of the numbers of different species of each group of organisms found in or around the study sites.

Site Similarity- Birds

Sites:	Allen	Murietta	Wakefield	Peck	Thompson	Haynes
Allen	-----	70%	61%	74%	70%	74%
Murietta	74%	-----	39%	42%	52%	48%
Wakefield	78%	67%	-----	61%	67%	56%
Peck	74%	56%	48%	----	48%	52%
Thompson	80%	80%	60%	55%	-----	60%
Haynes	61%	54%	48%	43%	43%	-----

Table 1.2- Data taken from the bird species list and compared between sites. The higher the percentage, the greater the similarity in species composition.

Site Similarity- Plants

Sites:	Allen	Murietta	Wakefield	Peck	Thompson	Haynes
Allen	-----	55%	24%	38%	38%	48%
Murietta	48%	-----	24%	42%	52%	48%
Wakefield	64%	73%	-----	36%	45%	55%
Peck	55%	70%	20%	----	50%	55%
Thompson	44%	68%	20%	40%	-----	44%
Haynes	41%	47%	18%	32%	32%	-----

Table 1.3- Data taken from the plant species list and compared between sites. The higher the percentage, the greater the similarity in species composition.

Capture Success

Site	Trap Nights	%Captures	P.m.	M.c.	O.t.	R.m.	M.m.	R.r.
Allen	318	15.4	49	0	0	0	0	0
Murietta	219	24.7	48	0	0	1	4	1
Wakefield	319	3.4	11	0	0	0	0	0
Peck	313	16.3	40	11	0	0	0	0
Thompson	318	7.9	24	0	1	0	0	0
Haynes	315	4.1	0	0	0	4	9	0

Table 1.4- Summarizes trapping success for the period

Total Captures

Site	7-20	7-22	7-27	7-29	8-3	8-7	T
Allen	8	12	13		9	7	49
Murietta	5*	7*	8		18	16	54
Wakefield	1	2	5	3	0		11
Peck	6	10	11	13	11		51
Thompson	4		7	7	3	4	25
Haynes	2		4	5	0	2	13
							203

Table 1.5- Summarizes the trapping success for the study period in absolute numbers for each site.

Peromyscus Captures

Site	7-20	7-22	7-27	7-29	8-3	8-7	T
Allen	8	12	13		9	7	49
Murietta	4*	7*	6		16	15	48
Wakefield	1	2	5	3	0		11
Peck	5	9	8	10	8		40
Thompson	3		7	7	3	4	24
Haynes	0		0	0	0	0	0
							172

Table 1.6- Summarizes the trapping success for the most prevalent rodent found in the study sites. Notice that no Peromyscus were caught at Haynes during the period.

Per Cent Traps Capturing Peromyscus

Site	7-20	7-22	7-27	7-29	8-3	8-7
Allen	100%	100%	100%		100%	100%
Murietta	80%	100%	75%		89%	94%
Wakefield	100%	100%	100%	100%	--	
Peck	83%	90%	73%	77%	73%	
Thompson	75%		100%	100%	100%	100%
Haynes	0%		0%	0%	--	0%

Table 1.7- Data taken from Table 1.6 and expressed in percentages. Note that for most sites few rodents other than Peromyscus were caught.

*only one quarter of the traps were set out due to irrigation

AGROFORESTRY PROJECT

PLANT LIST

Common Name	Family	Scientific Name	Location
Wild Oat	Poaceae	Avena fatua	A
Barnyard Grass	"	Echinochloa crusgalli	M P T H
Rabbitfoot Grass	"	Polypogon monspeliensis	P T
Littleseed Canarygrass	"	Phalaris minor	A T
Large Bermuda Grass	"	Cynodon dactylon	A H
Bearded Spangletop	"	Leptochola fascicularis	M P T
Timothy Grass	"	Phleum pratense	M
Common Foxtail-Barley	"	Hordeum leporinum/vulgare	A
Alkali Rye	"	Elymus triticoides	H
Ripgut Brome	"	Bromus rigidus	T
Red Brome	"	Bromus rubens	T H
Quackgrass	"	Agropyron repens	T
Johnson Grass	"	Sorghum halepense	H
Dallisgrass	"	Paspalum dilatatum	H
Saltgrass	"	Distichlis spicata	H
Sunflower	Asteraceae	Helianthus annuus	A M W P T H
Western Goldenrod	"	Solidago occidentalis	A M P
Common Groundsel	"	Senecio vulgaris	A M P T
Sowthistle	"	Sonchus oleraceus	A M W P T H
Prickly Lettuce	"	Lactuca scariola	A M T H
Mare's Tail	"	Conyza canadensis	M P H
Cocklebur	"	Xanthium canadense	P
Russian Knapweed	"	Centaurea repens	T
Telegraph plant	"	Heterotheca grandiflora	M W H
Bull (or Milk) Thistle	"	Cirsium vulgare	P H
Common Spikeweed	"	Hemizonia pugens	H
Curly Dock	Polygonaceae	Rumex crispus	A M P H
Black Bindweed	"	Polygonum convolvulus	A
Common Knotweed	"	Polygonum aviculare	A M W T
Silversheath knotweed	"	Polygonum argyrocoleon	
Swamp Smartweed	"	Polygonum lapathifolium	A
Jimson Weed	Solanaceae	Datura metaloides	A H
Chinese Thornapple	"	Datura ferox	M P
Deadly Nightshade	"	Solanum nigrum	A M T H
Ground Cherry	"	Physalis angulata var.	A M W
Hedge Mustard	Brassicaceae	Sisymbrium officinale	A
London Rocket	"	Sisymbrium irio	M T
Black Mustard	"	Brassica nigra	A
Nannie's Purse	"	Capsella procumbens	A M
Shepherd's Purse	"	Capsella bursa-pastoris	P
Burclover	Fabaceae	Medicago hispida	A
Alfalfa	"	Medicago sativa	A M P
Annual Yellow Sweetclover	"	Melilotus indica	A W P H
White Melilot	"	Melilotus albus	H

AGROFORESTRY PROJECT

PLANT LIST

Wild Morning Glory	Convolulaceae	Convolvulus arvensis	A	M		P	T		
Cressa	"	Cressa truxillensis							H
Largeseed Dodder	Cuscutaceae	Cuscuta indecora				P			H
Tumbling Pigweed	Amaranthaceae	Amaranthus blitoides	A	M		P	T		H
Prostrate Pigweed	"	Amaranthus albus	A	M		P	T		H
Rough Pigweed	"	Amaranthus retroflexus		M			T		H
Common Purslane	Portulacaceae	Portulaca oleracea		M	W		T		
Red Maids	"	Calandrinia ciliata		M	W				
Lambsquarters	Chenopodiaceae	Chenopodium album	A	M					H
Saltbush	"	Atriplex patula var.		M			T		H
Five-hook Bassia	"	Bassia hyssopifolia	A	M	W	P	T		H
Alkali Blite	"	Suaeda fruticosa							H
Russian Thistle (Tumbleweed)	"	Salsola iberica		M					H
Cheeseweed	Malvaceae	Malva parviflora					T		
Alkali Mallow	"	Sida leprosa		M					H
Panicled Willow-herb	Onagraceae	Epilobium paniculatum		M					
Red-stemmed Filaree	Gerinaceae	Erodium cicutarium	A		W				H
Yellow Nutgrass	Cyperaceae	Cyperus esculentus	A						H
Hardstem Bulrush	"	Scirpus acutus							H
Puncture Vine	Zygophyllaceae	Tribulus terrestris					T		
Horse Purslane	"	Trianthema portulacastrum		M					
Corn Spurry	Caryllophyllaceae	Spergula arvensis		M					
Spurry	"	Spercularia bocconii		M			T		
Turkey Mullein	Euphorbiaceae	Eremocarpus setigerus			W				
Seaside Heliotrope	Boraginaceae	Heliotropum curassivicum							H
Common Cattail	Typhaceae	Typha latifolia							H

		A	M	W	P	T	H
65 species	21 families	29	33	11	20	25	34

AGROFORESTRY PROJECT

Clip Plot Analysis

ALLEN- 25 samples = 0.25 sq. m.
2 hectares = 20000 sq. m.

Species	Stems	%Total	Grams	%Total	G/S	Occ.	S/H	G/H
C. arvensis	5	100%	32	100%	6.4	8%	20000	142000

MUREITTA- 26 samples = 2.34 sq. m.
9.4 hectares = 94000 sq. m.

Species	Stems	%Total	Grams	%Total	G/S	Occ.	S/H	G/H
A. patula	6	11%	113	42%	18.8	8%	25641	482906
S. arvensis	10	19%	32	12%	3.2	15%	42735	136752
S. oleraceus	9	17%	16.5	6%	1.8	9%	38462	70513
E. crusgalli	21	39%	1	<1%	<1	12%	89744	4274
A. blitoides	1	2%	<1	<1	<1	4%	4274	
L. scariola	3	6%	99	37%	33	8%	12821	423077
C. arvensis	4	7%	8	2%	1.25	4%	17094	21368
7 species	54	101%	266.5	99%			230771	1138890

WAKEFIELD- Section 1, 2 year old trees
8 samples = .72 sq. m.
exact acreage unknown

Species	Stems	%Total	Grams	%Total	G/S	Occ.
A. albus	35	78%	220	97%	6.4	37.5%
A. blitoides	8	18%	3.5	2%	<1	37.5%
E. cicutarium	1	2%	1	<1	1	12%
P. oleracea	1	2%	3.5	2%	3.5	12%
4 species	45	100%	227.5	101%		

Section 2, 3 year old trees
13 samples = 1.17 sq. m.
All samples empty

Section 3, 4 year old trees
8 samples = .72 sq. m.
All samples empty

Stems= total number of stems of particular species
%Total= ratio of species stems to total number of stems for site
Grams= total number of grams of particular species
%Total= ratio of species grams to total number of grams for site
G/S= grams per stem average
Occ.= frequency of occurrence
S/H= estimated stems for particular species per hectare
G/H= estimated grams per particular species per hectare

A G R O F O R E S T R Y P R O J E C T

Clip Plot Analysis

BECK- 20 samples = 1.8 sq. m.
3.3 hectares = 33000 sq. m.

Species	Stems	%Total	Grams	%Total	G/S	Occ.	S/H	G/H
C. canadensis	1032	95%	2027	95%	2	100%	5733333	11261111
C. arvensis	47	4%	88.5	4%	1.9	20%	261111	491667
H. grandiflora	1	<1%	2	<1%	2	5%	55556	11111
C. canadensis	1	<1%	22	1%	22	5%	55556	122222
4 species	1081	99%	2139.5	100%			6105556	11886111

THOMPSON- 25 samples = 2.25 sq. m.
2.4 hectares = 24000 sq. m.
All samples empty

HAYNES East- 10 samples = .9 sq. m.
2.1 Hectares = 21000 sq. m.- Total

Species	Stems	%Total	Grams	%Total	G/S	Occ.	S/H	G/H
D. spicata	217	68%	123.5	24%	<1	35%	2411111	1372222
H. curassivicum	5	2%	208	41%	41.6	10%	55556	2311111
L. scariola	3	1%	37.5	7%	12.5	15%	33333	416667
M. albus	29	9%	4.5	1%	<1	20%	322222	50000
C. album	11	3%	<1	<1	<1	15%	122222	
C. trawillensis	16	5%	5	<1	<1	20%	177778	55556
C. canadensis	18	6%	44	9%	2.4	5%	200000	488889
H. pungens	5	2%	79	17%	15.8	10%	55556	877778
C. dactylon	11	3%	3.5	1%	<1	5%	122222	38889
Unknown	2	1%	<1	<1	<1	10%	22222	
10 species	317	100%	505	101%			3522222	5611112

HAYNES West- 10 samples = .9 sq. m.

Species	Stems	%Total	Grams	%Total	G/S	Occ.	S/H	G/H
E. hyssopifolia	19	8%	1124	62%	59.2	40%	211111	12488889
C. dactylon	19	8%	78.5	6%	4.1	30%	211111	872222
C. trawillensis	75	31%	72	5%	1	50%	833333	800000
E. crusgalli	109	45%	2.5	<1%	<1	10%	1211111	27778
M. albus	6	2%	18	1%	3	20%	66667	200000
L. scariola	1	<1%	23	2%	23	10%	11111	255556
D. spicata	3	1%	2	<1%	<1	10%	33333	22222
H. pungens	1	<1	33	2%	33	10%	11111	366667
C. album	5	2%	2.5	<1%	<1	10%	55556	27778
H. curassivicum	2	1%	2	<1%	1	10%	22222	22222
Unknown	1	<1	1	<1	1	10%	11111	11111
11 species	241	98%	1363	99%			22677777	22944445

AGROFORESTRY PROJECT

Line Intercept Analysis

ALLEN- 10 samples = 5000 cm
Total cover = .84%

Species	Dist.	% Total	Occ.	Ave. Size	% Cover
C. arvensis	42 cm	100%	10%	42 cm	.84%

MURIETTA- Section 1
10 samples = 5000 cm
Total cover = 24.82%

Species	Dist.	% Total	Occ.	Ave. Size	% Cover
A. patula	309 cm	25%	30%	103 cm	6%
L. scariola	232 cm	19%	50%	46.4 cm	5%
H. annuus	195 cm	16%	20%	97.5 cm	4%
P. aviculare	143 cm	12%	30%	47.7 cm	3%
S. bocconii	121 cm	10%	40%	30.25 cm	2%
S. oleraceus	114 cm	9%	90%	12.7 cm	2%
C. canadensis	54 cm	4%	30%	18 cm	1%
E. crusgalli	53 cm	4%	20%	26.5 cm	1%
F. angulata	12 cm	1%	20%	6 cm	<1%
R. crispus	6 cm	<1%	10%	6 cm	<1%
C. album	3 cm	<1%	10%	3 cm	<1%
11 species	1241 cm	100%			24%

Section 2
3 samples = 1500 cm
Total cover = 59.53%

Species	Dist.	% Total	Occ.	Ave. Size	% Cover
L. scariola	390 cm	44%	100%	130 cm	26%
A. patula	158 cm	18%	100%	52.7 cm	11%
C. album	129 cm	14%	67%	64.5 cm	9%
H. annuus	112 cm	13%	67%	56 cm	7%
C. canadensis	75 cm	8%	100%	25 cm	5%
S. bocconii	31 cm	3%	33%	31 cm	2%
6 species	893 cm	100%			60%

Dist.= total length of intercept by each species
% Total= percentage of sum of intercept of all species
Occ.= frequency of occurance on intercept
Ave. Size= average size of species intercept
% Cover= percentage of intercept for each species for entire site

AGROFORESTRY PROJECT

Line Intercept Analysis

MURIETTA-

Section 3
3 samples = 1500 cm
Total cover = 28%

Species	Dist.	% Total	Occ.	Ave. Size	% Cover
C. arvensis	369 cm	88%	33%	369 cm	25%
E. crusgalli	38 cm	9%	33%	38 cm	3%
P. monspeliensis	6 cm	1%	33%	6 cm	<1%
S. oleraceus	7 cm	2%	67%	3.5 cm	<1%
4 species	420 cm	100%			28%

Section 4
3 samples = 1500 cm
Total cover = 2.67 %

Species	Dist.	% Total	Occ.	Ave. Size	% Cover
S. bocconii	38 cm	95%	67%	19 cm	3%
S. oleraceus	2 cm	5%	33%	2 cm	<1%
2 species	40 cm	100%			3%

WAKEFIELD- Section 1
3 samples = 1500 cm
Total cover = 67.27%

Species	Dist.	% Total	Occ.	Ave. Size	% Cover
A. albus	830 cm	82%	100%	276.7 cm	55%
A. blitoides	77 cm	8%	67%	38.5 cm	5%
H. grandiflora	38 cm	4%	33%	38 cm	3%
P. oleracea	34 cm	3%	33%	34 cm	2%
E. cicutarium	23 cm	2%	33%	23 cm	2%
S. oleraceus	7 cm	1%	33%	7 cm	<1%
6 species	1009 cm	100%			67%

Section 2
5 samples = 2500 cm
Total cover = 0%

Section 3
3 samples = 1500 cm
Total cover = 0%

PECK- 12 samples = 6000 cm
Total cover = 115.12%

Species	Dist.	% Total	Occ.	Ave. Size	% Cover
C. canadensis	5524 cm	80%	100%	460.3 cm	92%
C. arvensis	861 cm	12%	33%	215.25 cm	14%
H. annuus	365 cm	5%	17%	182.5 cm	6%
H. grandiflora	60 cm	1%	17%	30 cm	1%
L. scariola	53 cm	1%	42%	10.6 cm	1%
B. hyssopifolia	34 cm	<1%	8%	34 cm	<1%
6 species	6907 cm	99%			114 %

AGROFORESTRY PROJECT

Line Intercept Analysis

THOMPSON- 10 samples = 5000 cm
Total cover = 2.42%

Species	Dist.	% Total	Occ.	Ave. Size	% Cover
A. albus	89 cm	74%	10%	89 cm	2%
S. vulgaris	25 cm	21%	10%	25 cm	<1%
T. terrestris	7 cm	6%	10%	7 cm	<1%
3 species	121 cm	101%			2%

HAYNES East-
5 samples = 2500 cm
Total cover = 91.6%

Species	Dist.	% Total	Occ.	Ave. Size	% Cover
D. sqicata	701 cm	31%	80%	175.25 cm	28%
H. curassivicum	617 cm	27%	40%	308.5 cm	25%
H. pungens	561 cm	24%	40%	280.5 cm	22%
C. traxillensis	290 cm	13%	60%	96.7 cm	11%
C. canadensis	50 cm	2%	20%	50 cm	2%
C. album	38 cm	2%	20%	38 cm	2%
Unknown	28 cm	1%	20%	28 cm	1%
M. albus	4 cm	<1%	20%	4 cm	<1%
L. scariola	3 cm	<1%	20%	3 cm	<1%
9 species	2290 cm	100%			91%

HAYNES West-
5 samples = 2500 cm
Total cover = 136.32%

Species	Dist.	% Total	Occ.	Ave. Size	% Cover
B. hyssopifolia	783 cm	23%	60%	261 cm	31%
C. dactylon	675 cm	20%	60%	225 cm	27%
C. traxillensis	578 cm	17%	60%	192.7 cm	23%
E. crusgalli	465 cm	14%	40%	232.5 cm	19%
M. albus	275 cm	8%	20%	275 cm	11%
H. curassivicum	187 cm	5%	40%	93.5 cm	7%
H. pungens	180 cm	5%	40%	90 cm	7%
C. album	112 cm	3%	40%	56 cm	4%
L. scariola	102 cm	3%	40%	51 cm	4%
H. annuus	45 cm	1%	20%	45 cm	2%
H. grandiflora	6 cm	<1%	20%	6 cm	<1%
11 species	3408 cm	99%			137%

SECTION 8.0

Salt/Water Balance Study

EXHIBIT A
Agreement No. 9083
CSU, Fresno

Agroforestry Demonstration Program -- Water and Salt Balance

Principal Investigator: Kenneth H. Solomon, Ph.D., P.E., Director, Center for Irrigation Technology

PROJECT OBJECTIVES

The objectives of this project are to investigate: (1) the water and salt balance in the agroforestry system on a selected farm; and (2) the potential for reducing the volume of irrigation and drainage water and overall salt load in a farming system.

The objectives also include the installation of a drainage system and observation wells.

EXPECTED RESULTS

The water and salt balance in a farming system is affected by hydrological characteristics of the area, cropping systems, climatological conditions, water management practices on a given farm and in the surrounding area, and other factors. This type of project needs an operational period of several years to obtain results applicable to on-farm operations.

Under the assumption of project funding for 4 to 5 years, the following results are expected:

1. How effective trees and biofilter plants are in lowering the water table.

2. The input/output data on salts and water on a selected farm.

3. The evapotranspiration rates of trees and biofilter plants.

4. The salt absorption rates of trees and biofilter plants.

5. How effective trees and biofilter plants are in reducing the volume of irrigation water on a farm.

6. How effective trees and biofilter plants are in reducing the volume of drainage water on a farm.

7. How effective trees and biofilter plants are in reducing the salt load.

8. The development of farm management techniques to achieve optimum stability of salt and water conditions on a farm.

9. The effect of such techniques on crops, trees, and biofilter plants yield and quality.

METHOD

Project site:

Murietta farm, Fresno county

Data to monitor on the Murietta farm:

* Level of water tables (using observation wells)
* EC of water in observation wells
* Volume and EC of irrigation water applied to crops in the research area (RA)
* Volume and EC of drainage water outflow from RA
* Volume and EC of drainage/irrigation water applied to trees
* Volume and EC of drainage water outflow from the tree area
* Volume and EC of drainage/irrigation water applied to biofilter plants
* Volume and EC of drainage water outflow from the biofilter plant area
* Volume and EC of water delivered from the project to a drainage water disposal site
* Salt uptake by crops, trees, and biofilter plants
* Soil and water analysis from the areas of crops, trees, and biofilter plants
* Yields and production data on crops, trees, and biofilter plants
* Chemical composition of crops, trees, and biofilter plants
* Other data as needed for the study of water and salt balance

Technical and logistic support for the study:

1. Boundaries of the research area -- the fields surrounding the Agroforestry Demonstration Site, west from the San Luis drain at Jensen Road.

2. Location of the site for biofilter plants -- next to the Agroforestry Demonstration Site.

3. Location of a subsurface drain -- in the areas of the Agroforestry Demonstration Site and the biofilter plants.

4. Location of observation wells -- in a grid system, on the Agroforestry Demonstration Site and the biofilter plants.

5. Pumps and irrigation systems -- crops and trees - presently installed and used; biofilter plants - new installation required.

6. Disposal of drainage water from the biofilter plant site -- cooperation with the Westlands Water District required for the final disposal of this drainage water (selenium removal plant, deep well injection, or other method).

Frequency of data collection:

1. Related to on-farm operations (e.g., corresponding to the frequency of irrigation).

2. Two-week intervals (e.g., level of water tables, water EC in observation wells).

3. Semi-annually (e.g., soil, water, and plant tissue analysis).

COOPERATORS

The following agencies will cooperate in this project, and their responsibilities include:

Murietta Farms

Will provide land, crops, trees, and biofilter plants; farm management, irrigation, cultural practices; provide data about on-farm operations; installation of a subsurface drain (funded by the program) in cooperation with the USDA-SCS and other cooperators.

California Department of Food and Agriculture and U. S. Department of Agriculture-Soil Conservation Service

Overall program management; coordination of this water/salt balance study with other Agroforestry Demonstration Program projects, such as Tree Selection and Propagation, Wildlife Habitat, and Economics of Agroforestry; securing of funds for all phases of this project; interaction of agroforestry and water/salt management on farms.

University of California, Davis

Research design of the project; scientific evaluation of monitored data; preparation of progress and final reports.

California State University, Fresno

Data monitoring, analysis and reporting; installing of observation wells with the assistance of other cooperators.

SCHEDULE

	1987 ssfw	1988 ssfw	1989 ssfw	1990 ssfw	1991 ssfw
RESEARCH DESIGN	-xx-				
SITE DESIGN	-xx-				
SUBSURFACE DRAIN	-xx-				
OBSERVATION WELLS	-xx-				
PUMPS/IRRI EQUIP	-xx-				
DATA MONITORING	-xxx	xxxx	xxxx	xxxx	xxxx
DATA ANALYSIS	---x	xxxx	xxxx	xxxx	xxxx
PROGRESS REPORTS	---x	-x-x	-x-x	-x-x	-x--
FINAL REPORT			(x)		---x
WORKSHOPS			-x--	--x-	---x

Note: The present funding may be sufficient only until June 30, 1989. Additional funds are requested.

SECTION 9.0

Halophyte Biofilter Trial

Carolyn Watson
Environmental Research Laboratory
University of Arizona, Tuscon

AGROFORESTRY AND HALOPHYTE DEMONSTRATION PROGRAM FOR THE MANAGEMENT OF DRAINAGE WATER DISPOSAL

INTRODUCTION

Continuation of the agroforestry demonstration program on farms affected by drainage and salinity problems will further support this system as a method for management of San Joaquin's drainage water. This agroforestry system concept includes the reduction in drainage water volume and salt load and provision of tree by-products. Demonstration of this program is currently being conducted by cooperators headed by the California Department of Food and Agriculture (CDFA) and the U. S. Department of Agriculture-Soil Conservation Service (USDA-SCS).

The inclusion of halophytes as biofilter plants have been proposed to be an important component in the reduction of the salt/chemical load of drainage water. Field trial studies conducted in Mendota, California during 1986 have demonstrated the high productivies and regrowth abilities of Atriplex species, even when irrigated with saline water too high to support the growth of salt-tolerant trees. A summary of plant tissue chemical composition of various Atriplex species and other halophytes from these field trial studies is presented in Table 1. Results indicate that halophytes differ in their abilities to accumulate salt, Selenium and Boron. Average overall ash content of Atriplex species, which ranged from 17 to 36 percent, are relatively high when compared to conventional crops. Plant tissue Selenium levels of Atriplex barclayana, Atriplex lentiformis and Atriplex canescens were two to four times higher when irrigated with drainage water. The accumulation of Selenium in the plant tissue could provide a concentrated source of this element to be incorporated into a ruminant's feed ration. Crude protein content of clipped Atriplex plants averages around 15 percent and would also be a valuable component in a feed ration. Integration of the productivities, agronomic characteristics and chemical compostion of various halophytes have resulted in a selection of candidates for further evaluation in the proposed agroforesty and halophyte demonstration program.

Halophyte Research Area

PROJECT DESCRIPTION AND DEVELOPMENT

I. Site Location and Description

The halophyte research area will be south of the tree plantation site on Murrieta Farms in Mendota, California. Total area for the halophyte demonstration program will be five acres. Irrigation water to the trees will be with drainage water and/or a blend of drainage water. Irrigation water to the halophytes will be with the drainage water collected from the subsurface drains installed under the tree research area.

II. Salt and Water Balance Research Activities

The agroforestry demonstration program, coordinated by the CFDA, USDA-SCS, California Department of Water Resources, University of California (Davis), California State University (Fresno) and California Agriculture Technology Institute will provide the following supplies, services and activities during the proposed 1987/1988 fiscal year.

1. Design and installation of subsurface drains, observation wells and in-line flow meters for the agroforestry and halophyte research areas.
2. Data monitoring of salt and volume of groundwater, irrigation water and drainage water through the agroforestry and halophyte research areas and evaluation of the water/salt balance study.
3. Analyses of soil and plant material at tree research site and of soil at Atriplex research site.
4. Measuring the evapotranspiration rates of trees and selected halophytes.

PROJECT IMPLEMENTATION

Required funds to support the five acre halophyte research area in coordination with the agroforestry demonstration program are listed in the Budget. Responsibilities and activities of the cooperators are described below.

I. Murrieta Farms

1. Materials and installation of irrigation system in halophyte research area.
2. Weed, pest and disease control, planting and harvesting, irrigation, fertilization and other farm operations to implement appropriate cultural practices in the halophyte research area.

II. University of Arizona

1. Selection and provision of stem cuttings and seed stock for the halophyte research area.
2. Analyses and evaluation of harvested Atriplex material for salt and mineral uptake and forage quality.
3. Consultation on plant growth and development, planting dates, cultural practices, harvest times and method for the Atriplex and other halophyte crops.

III. Cultural practices of the halophyte research area

During the 1986 field trials conducted on Murrieta farms, a total of 20 halophyte accessions from the Environmental Research Laboratory were evaluated for overall performance. Accessions

which demonstrated slow productivities, undesirable agronomic characteristics and slow regrowth were eliminated from the list of candidate plants. During the proposed 1988 halophyte field trials, a total of 10 Atriplex species and appromimately 5 species of other halophytes will be evaluated for productivities, chemical composition and forage quality. Some of the most promising candidates of which seed is not currently available will be propagated by stem cuttings. The remaining species have a commercially available seed source and will be direct-seeded. Demonstration of direct-seeding for halophyte establishment will be important in the long-term economics of a halophyte plantation.

Atriplex will be direct-seeded between January 15 and February 15. A late winter planting date allows exposure of the seed to rainfall and low temperatures which enhances overall germination. All seed will be pretreated with fungicide before planting to control seedling damping-off. After stand is established, some hand-thinning may be necessary to achieve the desired spacing. Stem cuttings of selected Atriplex and other halophytes will be started during mid-December through mid-January for transplanting into the research area no later than March 15.

Plant spacing between and within rows will be between 2.0 and 2.5 feet. Each species will be seeded or transplanted into plot strips having widths to accomodate harvest equipment. An intensive weed control program is anticipated during the first year of shrub establishment.

It has been shown that shedding of leaves and flower parts in Atriplex may increase the salinity and sodicity of the soil surface. Multiple clippings to remove the top plant portions will promote the removal of salt from the irrigated land.

It is anticipated that some of the most productive Atriplex species will have two clipping harvests during the establishment year. The criteria for timing of harvest and clipping height will vary among the various accessions. Scheduling of harvest times and clipping height will be critical to the regrowth recovery of the clipped plants.

Multiple clippings will reduce the size and growth form and modify the shrubs structural features, thereby reducing attractibility to game birds. This feature is considered to be ecologically important by discouraging Kesterson-type problems within the halophyte plantings.

Table 1. Plant tissue analyses (dry weight basis) of halophytes grown at Site 1 (fresh water irrigated) and Site 2 (drainage water irrigated)

Species: Accession #	Site #	Clipped #	Ash	Protein	B	Se
			-------%	-------	--ppm---	
A. nummularia - 489	1	1	27.9	17.4		
A. nummularia - 489	1	2	25.8	13.3		
A. nummularia - 709	1	1	27.3	19.0		
A. nummularia - 709	1	2	23.7	18.6		
A. canescens - 606	1	1	19.5	14.6		
A. canescens - 606	1	2	14.9	12.9		
A. canescens - 824	2	1				1.34
A. cansecens - 824	1	1	18.8	16.2		0.46
A. canescens - 824	1	2	16.5	14.7		
A. barclayana	2	1	39.5	22.0	43.9	1.04
A. barclayana	1	1	33.7	12.6	55.3	0.54
A. barclayana	1	2	33.2	11.1		
A. lentiformis- 710	2	1	22.5	17.2	12.8	0.91
A. lentiformis- 710	1	1	18.2	9.1	6.7	0.25
A. lentiformis- 710	1	2	21.3	11.3		
A. camarones - 203	2	1	28.9	13.3	6.3	0.63
A. bolusii - 488	2	1	36.0	16.1	28.7	0.52
A. deserticola- 288	2	1a	31.1	20.4		
A. deserticola- 288	2	1b	29.8	11.9	6.4	0.81
A. undulata - 163	2	1a	30.8	19.5		
A. undulata - 163	2	1b	34.5	12.5	30.0	
A. sp. - 873	2	1	26.6	18.7		
A. bunburyana - 463	2	1	25.8	18.6		
Salicornia	1	whole plant	33.1	10.1	132.0	
Suaeda sp.	1	whole plant	29.3	19.2	31.3	

SECTION 10.0

Financial Information

STATE WATER RESOURCES CONTROL BOARD (SWRCB)
Agreement # 7859

Agroforestry Program

AGFO CONTRACT
SUBFILES: DELLABAL
SJVFBAL
CORNFBAL
ZAPPEBAL
FOOTEBAL
OTHERBAL

DATE	SUBFILE PAYMENT LISTED IN	INVOICE, PAYMENT OR CHECK NUMBER	AMOUNT PAID OUT BY CDFA	AMOUNT SUBMITTED TO SWRCB	AMOUNT REIMBURSED BY SWRCB	10 % DEFERRED BALANCE	BALANCE OF CONTRACT	COMMENTS
							50,000	
2/28/86	SJVFBAL	152063	5,550					Deposit on 100,000 Eucalyptus
2/28/86	CORNFBAL	152063	750					Deposit on 5,000 Casuarina
2/28/86	ZAPPEBAL	152063	530					1,000 poplar seedlings
3/7/86	CORNFBAL I	4369	109					Seed procurement costs
?	SJVFBAL	?	5,580					Balance of previous order
?	CORNFBAL I	7465	2,070					Balance of previous order
2/9/87		pmt req #1		14,588				See payment request #1
2/25/87		DB870304			13,128	1,460	35,412	See DBase No. 870304
7/25/86+?	OTHRBAL	5001-116	90					Farm Pump & Irrig. Co., PVC pipe & supplies
1/6/87	SJVFBAL	C07-057654	3,313					Down payment on agreement #8890
2/19/87	OTHRBAL	6002-116	(214)					The Bioengineering Corp., Selfin & Biotron ineligible for reimbursement
3/10/87?	OTHRBAL	6001-116	954					Planter from Miles Merwin
4/23/87+	FOOTEBAL I	8744	153					576 Eucalyptus seedlings
6/3/87		pmt req #2		4,723				See payment request #2
7/2/87	SJVFBAL	?	3,313					Final payment on agmt. 8890
8/17/87	DELLABAL	inv872974	2,970					5 soil @ $290, 4 water @ $380
9/23/87	DELLABAL	inv873582	75					Plant tissue:Se @$35, Feed analysis @ $40
9/30/87		RC97970			2,982	331	32,099	Reimbursement for SJF invoice only ($3313) balance due=4723-214(inelig.)-3313 = 1196

DELLAVALLE LABORATORY, INC.
Agreement # 8891

DELLABAL
SWRCB SUBCONTRACT

Agroforestry Program

DATE	DESCRIPTION OF ITEM	CHECK OR INVOICE NUMBER	AMOUNT BILLED TO CDFA	AMOUNT PAID BY CDFA	AMOUNT OUT-STANDING	BALANCE OF CONTRACT	COMMENTS
12/31/86						15,000	
7/27/87	5 soil samples 4 water samples	872974	2,970		2,970		soil @ $290 ea. water @ 380 ea.
8/17/87	pmt on 872974			2970	0	12030	date sent to accts payable
9/21/97	Plant tissue/Se Feed Analysis	873582	75		75		Tissue @ $35 Feed @ $40
9/23/87	pmt on 873582			75	0	11,955	date sent to accts payable

SAN JOAQUIN VALLEY FOLIAGE, INC. SJVFBAL
Seedling Purchases SWRCB NON-CONTRACTED EXPENSES
Agroforestry Program

DATE	CHECK OR INVOICE NUMBER	AMOUNT BILLED TO CDFA	AMOUNT PAID BY CDFA	AMOUNT OUT-STANDING	TOTAL PAID	COMMENTS
1/31/86	DB 860203	5,000		5,000		Deposit for 100,000 E. camaldulensis @ $0.105 each
2/28/86	C 152063		5,550	0	5,550	reimbursement to WRCD for deposit (1/2 of $ 11,130 cost) Includes $5,000 invoice
7/9/86	none	5,580		5,580		Balance of previous order
?	?		5,580	0	11,130	Payment of 7/9/86 invoice, See invoice for approval
2/9/87	Payment request #1 including $11,130 submitted to SWRCB					
12/1/86	none	3,313		3,313		invoice for contract # 8890 30,000 Euc., Lake Albacutya 18,000 Euc., Mt. Bernstein @ $0.125 each, total $6625
1/6/87+	C07-057654		3,313	0	14,443	payment of contract invoice date of approval shown
6/3/87	Payment request #2 including $3,312.50 submitted to SWRCB					
4/29/87?	none	3,313		3,313		2nd payment on agmt. 8890, same invoice as 1st pmt, date hand written in corner
7/2/87	?		3,313	0	17,755	payment on contract 8890

CORNFLOWER FARMS
Seedling Purchases
Agroforestry Program

CORNFBAL
SWRCB NON-CONTRACTED EXPENSES

DATE	CHECK OR INVOICE NUMBER	AMOUNT BILLED TO CDFA	AMOUNT PAID BY CDFA	AMOUNT OUT-STANDING	TOTAL PAID	COMMENTS
2/14/86	I 4369	109		109		Seed procurement costs C. glauca, C. cunninghamiana
?	I 9448	750		859		no date, deposit for 5,000 Casuarina @ $0.30 each
2/28/86	C 152063		750	109	750	reimbursement to WRCD for deposit payment
3/7/86 ?	I 4369		109	0	859	date is when payment was approved for inv. 4369
7/9/86	I 7465	2,070		2,070		3137 C. cunninghamiana, 3131 C. glauca, 382 E. grandis @ $0.40 each (containers & tax included)
?	I 7465		2,070	0	2,929	balance of invoice 7465 $750 deposit already paid
2/9/87 Payment Request #1 including $2,929 submitted to SWRCB						
4/16/87		160		160		400 Casuarina seedlings @ $0.40 each

GEORGE ZAPPETTINI
Seedling Purchases
Agroforestry Program

ZAPPEBAL
SWRCB NON-CONTRACTED EXPENSES

DATE	CHECK OR INVOICE NUMBER	AMOUNT BILLED TO CDFA	AMOUNT PAID BY CDFA	AMOUNT OUT-STANDING	TOTAL PAID	COMMENTS
2/6/86	I 4999	530		530		500 "Jaconotti" hybrid poplar 500 P. nigra-columme, @ $0.50 ea.
2/28/86	C 152063		530	0	530	payment for invoice 4999
2/9/87	Payment request #1 including $530 submitted to SWRCB					

FOOTE'S EUCALUPTUS SEEDLINGS
Seedling Purchases
Agroforestry Program

FOOTEBAL
SWRCB NON-CONTRACTED EXPENSES

DATE	CHECK OR INVOICE NUMBER	AMOUNT BILLED TO CDFA	AMOUNT PAID BY CDFA	AMOUNT OUT-STANDING	TOTAL PAID	COMMENTS
4/23/87	I 8744	153		153		576 Eucalyptus seedlings, Stratford Provenence @ $0.25 each
?	I 8744		153	0	153	payment on invoice 8744
6/3/87	Payment request #2 including $152.64 submitted to SWRCB					

OTHER EXPENSES

OTHERBAL
SWRCB NON CONTRACTED EXPENSES

Agroforestry Program

DATE	VENDER	INVOICE NUMBER	AMOUNT BILLED TO CDFA	AMOUNT PAID BY CDFA	AMOUNT OUT-STANDING	TOTAL PAID	COMMENTS
7/25/86	Farm Pump & Irrigation Co.	5001-116	90		90		30 - 1.5" X 10' PVC class 125 pipe 37 - 1.2" slip PVC caps 1 quart 717 PVC cement shop labor:set up & cut 10' lengths
?	Farm Pump & Irrigation Co.	5001-116		90	0	90	
2/11/87	Bioengineering Corp.	6002-116	214		214		12 Kg Selfin @ $11.00/Kg 2 Kg Biotron @ $35.00/Kg
2/19/87	Bioengineering Corp.	6002-116		214	0	304	
2/27/87	Miles & Eliz. Merwin	6001-116	954		954		tree planter with trailer
3/10/87?	Miles & Eliz. Merwin	6001-116		954	0	1,258	cancels agreement #7878 for lease of planter

6/3/87 Payment Request #2 including $1,257.72 for other submitted to SWRCB

U.S. DEPARTMENT OF THE INTERIOR-BUREAU OF RECLAIMATION (USBOR) USBRBAL
CDFA Agreement # 9049 AGFO CONTRACT
USBOR No. 7-FC-20-04900 SUBFILES:SACHSBAL
Agroforestry Program LOHRBAL
CHESEBAL

DATE	PAYMENT LISTED IN SUBFILE	INVOICE NUMBER	AMOUNT PAID OUT BY CDFA	AMOUNT SUBMITTED TO USBR	AMOUNT REIMBURSED BY USBR	BALANCE OF CONTRACT	COMMENTS
						60,000	
5/ /87	LOHRBAL	3239825	629				April wages
5/12/87+	SACHSBAL	050750	9,431				First contract payment Date payment approved is shown
6/ /87	LOHRBAL	3560132	718				May wages
7/3/87	LOHRBAL	3872823	754				June wages
8/4/87	LOHRBAL	1178614	790				July wages
8/ /87				12,323			Invoices submitted for reimbursement
9/3/87	LOHRBAL	1477289	790				August wages
10/5/87	LOHRBAL	1775250	799				September wages
10/7/87	CHESEBAL	13032	8,000				First contract payment Date payment approved is shown
10/5/87					12,323	47,677	1st reimbursement

Total Paid 8/4/87 21,912

UCD - ROY SACHS
Agreement # 9016

SACHSBAL
USBOR SUBCONTRACT

Agroforestry Program

DATE	DESCRIPTION OF ITEM	INVOICE NUMBER	AMOUNT BILLED TO CDFA	AMOUNT PAID BY CDFA	AMOUNT OUT-STANDING	BALANCE OF CONTRACT	COMMENTS
3/1/87	contract					31,438	
4/29/87	contractor inv.	050750	9,431		9,341		
5/12/87+	approved pmt.	050750		9,431	0	22,007	Payment of invoice 050750

UCD - LU LOHR

LOHRBAL
USBOR NON-CONTRACTED EXPENSE

Agroforestry Program

DATE	MONTH OF PAY PERIOD	HOURS WORKED	WARRANT NUMBER	GROSS AMOUNT PAID BY CDFA	AMOUNT SUBMITTED TO USBOR	TOTAL PAID	COMMENTS
5/ /87	April	70	3239825	628.60		628.60	
6/ /87	May	80	3560132	718.40		1347.00	
7/3/87	June	84	3872823	754.32		2101.32	
8/4/87	July	88	1178614	790.24		2891.56	
8/20/87					2891.56		
9/3/87	August	88	1477289	790.24		3681.80	
10/5/87	September	89	1775250	799.22		4481.02	

CSUF - CHESEMORE
Agreement # 9076

CHESEBAL
USBOR SUBCONTRACT

Agroforestry Program

DATE	DESCRIPTION OF ITEM	CHECK OR INVOICE NUMBER	AMOUNT BILLED TO CDFA	AMOUNT PAID BY CDFA	AMOUNT OUT-STANDING	BALANCE OF CONTRACT	COMMENTS
6/4/87	contract					26,000	
7/1/87	1st payment	13032	8,000		8,000		1st pmt as per contract
10/7/87	1st payment	13032		8,000	0	18,000	date pmt approved is shown

CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE (CDFA) AGFO CONTRACT
SUBFILES:TANJIBAL
SOLOMBAL
CITBAL

Agroforestry Program

DATE	PAYMENT LISTED IN SUBFILE	CHECK OR INVOICE NUMBER	AMOUNT PAID OUT BY CDFA	BALANCE OF CONTRACT	COMMENTS
				80,000	
10/7/87	TANJIBAL	050918	5,000	75,000	1st payment on contract

UCD - TANJI
Agreement # 9084

TANJIBAL
CDFA SUBCONTRACT

Agroforestry Program

DATE	DESCRIPTION OF ITEM	CHECK OR INVOICE NUMBER	AMOUNT BILLED TO CDFA	AMOUNT PAID BY CDFA	AMOUNT OUT-STANDING	BALANCE OF CONTRACT	COMMENTS
6/25/87	contract					25,000	
8/10/87	1st payment	050918	5,000		5,000		pmt upon approval & signing of contract
10/7/87	1st payment	050918		5,000	0	20,000	date pmt approved is shown

CSUF - SOLOMON / WATER & SALT BALANCE
Agreement # 9083

SOLOMBAL
CDFA SUBCONTRACT

Agroforestry Program

DATE	DESCRIPTION OF ITEM	INVOICE NUMBER	AMOUNT BILLED TO CDFA	AMOUNT PAID BY CDFA	AMOUNT OUT-STANDING	BALANCE OF CONTRACT	COMMENTS
6/25/87	contract					50,000	

CSUF - SOLOMON (CIT) / WATER MONITORING
Agreement # 3516

CITBAL
CDFA SUBCONTRACT

Agroforestry Program

DATE	DESCRIPTION OF ITEM	INVOICE NUMBER	AMOUNT BILLED TO CDFA	AMOUNT PAID BY CDFA	AMOUNT OUT-STANDING	BALANCE OF CONTRACT	COMMENTS
6/19/87	contract					4,900	

SECTION 11.0

Agroforestry Directory

AGROFORESTRY MAILING LIST
(3/18/88)

Dave Adams (916) 322-0126
Department of Forestry
P. O. Box 1590
Davis, California 95617

Ron Adams (916) 753-2717
P. O. Box 561
Davis, California 95617

Gerald Ahlstrom (916) 322-0174
Department of Forestry
P. O. Box 944246
Sacramento, California 94244-2460

A. D. Allen (209) 659-3143
P. O. Box 696
Firebaugh, California 93622

Eugene E. Andreuccetti (916) 449-2848
State Conservationist
Soil Conservation Service
U. S. D. A.
2121-C Second Street, Suite 102
Davis, California 95616-2852

Virgil Backlund (916) 449-2819
Soil Conservation Service
U. S. D. A.
2121-C Second Street
Davis, California 95616

Thor Bailey (916) 893-1368
President
Energy Production
2279 Nord Avenue
Chico, California 95926

David A. Bainbridge (714) 787-5797
Dry Lands Research Institute 787-3785
University of California
Riverside, California 92521

Dennis Beeson (805) 322-7278
The Pacific Tree Company
904 East Brundage Lane
Bakersfield, California 93307

John Beyer (209) 487-5223
Soil Conservation Service
U. S. D. A.
1130 O Street, Room 3302
Fresno, California 93721

Ted Bloemhof (805) 758-5105
17851 Palm Avenue
Shafter, California 93263

W. (Bill) Brooks (916) 449-2881
Soil Conservation Service
U. S. D. A.
2121 C - Second Street
Davis, California 95616

Richard G. Burau (916) 752-0194
Director, Monterey Basin (916) 752-1491
Pilot Monitoring Project (916) 752-1142
Dept. of Land, Air and Water Resources
Dept. of Environmental Toxicology
University of California
Davis, California 95616

Jim Bushey (209) 584-9209
Soil Conservation Service
U. S. D. A.
1716 North 11th Avenue, Suite B
Hanford, California 93230

Buttonwillow Land and Cattle Co. (805) 764-5865
Attn: Larry Frey
Route 1, Box 177
Buttonwillow, California 93206

Sal Carollo (209) 924-9754
19212 19th Avenue
Stratford, California 93266

John Carter (916) 322-0107
Wood Energy Program
Department of Forestry
P. O. Box 944246
Sacramento, California 94244-2460

Vashek Cervinka (916) 445-6719
Research Manager
Agricultural Resources Branch
Department of Food and Agriculture
1220 N Street, Room 104
Sacramento, California 94271-0001

A. Dale Chapman
Chapman Forestry Foundation
P. O. Box 311
Davis, California 95616
(916) 756-3107

Dave Chesemore
Department of Biology
California State University
Fresno, California 93740
(209) 294-2010
294-2001

Ed Craddock
Office of Water Conservation
Department of Water Resources
1416 Ninth Street
Sacramento, California 95814
(916) 445-9958

Richard Daniel
Environmental Services Branch
Department of Fish and Game
1416 Ninth Street
Sacramento, California 95814
(916) 445-1383

Nat B. Dellavalle
Dellavalle Laboratory, Inc.
1910 W. McKinley, Suite 110
Fresno, California 93728
(209) 233-6129
Res. (209) 229-1797

Robert Delzell
Soil Conservation Service
U. S. D. A.
2121 C - Second Street
Davis, California 95616
(209) 449-2852

John Diener
Round Rock Ranch
P. O. Box 428
Five Points, California 93624
(209) 884-2234
(209) 884-2324

Don Duncan
San Joaquin Experimental Range
P. O. Box 91
O'Neals, California 93645
(209) 868-3349

Andy Dyer
Department of Biology
California State University
Fresno, California 93740
(209) 266-0664

Pamela Elam-Wenzel
Farm Advisor
Urban and Environmental Horticulture
University of California
1720 South Maple Avenue
Fresno, California 93702
(209) 488-3285

Laora Fanger-Vexler (415) 642-0279
Research Forester
University of California
233 Mulford Hall
Berkeley, California 94720

Steve Fedje (209) 584-9209
Soil Conservation Service
U. S. D. A.
1716 North 11th Avenue, Suite B
Hanford, California 93230

Peter F. Ffolliott (602) 621-7276
Professor
School of Renewable Natural Resources
The University of Arizona
Tucson, Arizona 85721

Clarence Finch (209) 487-5125
Soil Conservation Service
U. S. D. A.
1130 O Street, Room 2114
Fresno, California 93721

Sherman Finch (916) 449-2852
Forester RPF 190
Soil Conservation Service
U. S. D. A.
2121 C - Second Street
Davis, California 95616

Ann Fisher (916) 689-1015
Cornflower Farms
P. O. Box 896
Elk Grove, California 95624

Ray Foote (209) 924-2736
544 E. Meadow Lane
Lemoore, California 93245

Louise Fortman (415) 642-7018
Department of Forestry
Mulford Hall
University of California
Berkeley, California 94720

Terry Garvey (209) 224-1523
Chief Engineer
Westlands Water District
3130 North Fresno Street
Fresno, California 93703

Don Gasser (415) 642-5059
Department of Forestry
University of California
Berkeley, California 94720

Randall Godden (916) 551-1715
Cooperative Watershed Program
Forest Service
U. S. D. A.
2121 C - Second Street, Suite 102
Davis, California 95616

Clarence Gowens (209) 884-2248
P. O. Box 215
Five Points, California 93624

Stephen Grattan (916) 752-1103
Land, Air and Water Resources 752-0453
University of California
Davis, California 95616

O. P. Gulati (916) 324-5630
Senior Water Resources Control Engineer
Division of Water Rights
State Water Resources Control Board
901 P Street
Sacramento, California 95814

George Hanna (209) 294-2500
School of Engineering
122 East Engineering Building
Fresno, California 93740-0094

Blaine Hanson (916) 752-1130
Land, Air and Water Resources 752-0453
University of California
Davis, California 95616

Gene Hartzell (916) 322-2299
Nurseries and Tree Improvement
Department of Forestry
P. O. Box 1590
Davis, California 95617

Haynes and Sons (209) 582-5449
Attn: James C. Haynes/James C. Haynes, Jr.
1335 Lassen Drive
Hanford, California 93230

Cosmo C. Insalaco (209) 488-3510
Agricultural Commisioner
1730 South Maple Avenue
Fresno, California 93702

International Council for
Research in Agroforestry
P. O. Box 30677
Nairobi
KENYA, East Africa

Farouk T. Ismail (916) 322-3408
Chief, Technical Support 322-3600
State Water Resources Control Board
Division of Clean Water Grants
901 P Street
Sacramento, California 95814

Wesley Jarrell (714) 787-3785
Department of Soil and Environmental Sciences
University of California
2217 Geology Building
Riverside, California 92521

Bryan Jenkins (916) 752-1422
Agricultural Engineering Department
University of California
Davis, California 95616

Dan Johnson (209) 487-5125
Soil Conservation Service
U. S. D. A.
1130 O Street
Fresno, California 93721

Greg Jorgensen (209) 294-2066
Center for Irrigation Technology
California State University
Fresno, California 93740

Amram (Ron) Kadish (805) 482-5827
1980 Hobart Drive
Camarillo, California 93010

Martin M. Karpiscak (602) 621-1955
Research Scientist
Office of Arid Lands Studies
845 N. Park Avenue
The University of Arizona
Tucson, Arizona 85719

Herschel Kimble (805) 861-4129
District Conservationist
Soil Conservation Service
U. S. D. A.
5500 Ming Avenue, Suite 165
Bakersfield, California 93309

Kings Outreach Boys Ranch
Attn: Wesley Champlin
13787 Kansas Avenue
Hanford, California 93230
(209) 584-0181

Mike Kobzeff
San Joaquin Foliage, Inc.
6171 W. Olive Avenue
Fresno, California 93711
(209) 275-3608

Tom Ledig
Institute of Forest Genetics
P. O. Box 245
Berkeley, California 94701
(415) 486-3134

Ed Lee
U. S. Bureau of Reclamation
280 Cottage Way, MP-190 (Room W-2143)
Sacramento, California 95825
(916) 978-4969

Luanne Lohr
Department of Agricultural Economics
University of California
Davis, California 95616
(916) 752-6457

John B. Loomis
Division of Environmental Studies
University of California
Davis, California 95616
(916) 752-0523

Phil Lopez
Soil Conservationist
Soil Conservation Service
U. S. D. A.
5500 Ming Avenue, Suite 165
Bakersfield, California 93309
(805) 861-4129

Cecil V. Martin
Chief, Environmental Services Section
State Water Resources Control Board
Division of Water Quality
901 P Street
Sacramento, California 95814
(916) 322-6598

Jeanne Martin
Department of Forestry
P. O. Box 1590
Davis, California 95617
(916) 322-2299

Frank Menezes
Soil Conservation Service
U. S. D. A.
1716 North 11th Avenue, #B
Hanford, California 93230
(209) 584-9209

Miles Merwin (916) 795-2440
International Tree Crops Institute
P. O. Box 888
Winters, California 95694

George Miller, Jr. (916) 678-2496
7447 Pitt School Road
Dixon, California 95620

Steve Moore (916) 978-4969
U.S. Fish and Wildlife Service
San Joaquin Valley Drainage Program
MP-190, Room W-2143
2800 Cottage Way
Sacramento, California 95825

Murrieta Farms (209) 655-3221
Attn: David Woolley
5854 S. San Diego Avenue
Mendota, California 93640

Jim Nee (916) 978-4969
U.S. Fish and Wildlife Service
San Joaquin Valley Drainage Program
MP-190, Room W-2143
2800 Cottage Way
Sacramento, California 95825

Dan Nelson (209) 826-4043
San Luis Water District
P. O. Box 2135
Los Banos, California 93635

Bob Norona (209) 526-4100
Tri-Valley Growers ext 2270
P. O. Box 3327
Modesto, California 95353

Ralph Osterling (415) 573-8733
1650 Borel Way, Suite 204
San Mateo, California 94402

Robert Peyton (415) 644-4235
Special Projects
Agriculture and Natural Resources
2120 University Avenue, 7th Floor
Berkeley, California 94720

Claude J. Phene (209) 251-0437
Agricultural Research Service
2021 S. Peach Avenue
Fresno, California 93727

Pete Price (916) 445-1638
Principal Consultant
Assembly Office of Research
1100 J Street, Fifth Floor
Sacramento, California 95814

Larry K. Puckett (916) 978-4981
California Department of Fish and Game
San Joaquin Valley Drainage Program
MP-190, Room W-2143
2800 Cottage Way
Sacramento, California 95825

Raul Ramirez (805) 861-4129
Soil Conservationist
Soil Conservation Service
U. S. D. A.
5500 Ming Avenue, Suite 165
Bakersfield, California 93309

Ilona Rice (916) 322-6832
Research Assistant
Agricultural Resources Branch
Department of Food and Agriculture
1220 N Street, Room 104
Sacramento, California 94271-0001

Romeo A. "Rome" Rivera, P.E. (916) 449-2861
Leader, River Basin Planning Staff
Soil Conservation Service
U. S. D. A.
2121-C Second Street
Davis, California 95616

Gary Rose (209)992-3145
Tulare Lake Drainage District
P. O. Box 985
Corcoran, California 93212

Roy Sachs (916) 752-3071
Department of Environmental Horticulture
University of California
Davis, California 95616

Ronald Schultz (916) 449-2852
Soil Conservation Service
U. S. D. A.
2828 Chiles Road
Davis, California 95616

Jon Shaver, Director (209) 294-2361
California Agricultural Technology Institute
California State University
Fresno, California 93740

Bob Slayback
Soil Conservation Service
U. S. D. A.
2828 Chiles Road
Davis, California 95616
(916) 449-2852

Felix Smith
Habitat Resources
U. S. Fish and Wildlife Service
2800 Cottage Way
Sacramento, California 95825
(916) 978-4877

Ken Solomon
Director
Center for Irrigation Technology
California State University
Fresno, California 93740
(209) 294-2066

Rich Standiford
U. C. C. E. Forestry
University of California
Mulford Hall
Berkeley, California 94720
(415) 642-2360

Don Swain
Bureau of Reclamation
San Joaquin Valley Drainage Program
MP-190, Room W-2143
2800 Cottage Way
Sacramento, California 95825
(916) 978-4969

Ken Tanji
Land, Air and Water Resources
University of California
Davis, California 95616
(916) 752-0683
752-0453

Maurice H. Taylor
U. S. Fish and Wildlife Service
2800 Cottage Way
Sacramento, California 95825
(916) 978-4613

Ben Thompson
Nor-Cal Resources, Inc.
951 Live Oak Boulevard
Yuba City, California 95991
(916) 674-2908

Thomsen Brothers
Attn: Tom Thomsen
P. O. Box 258
Cantua Creek, California 93608
(209) 829-6469

Timothy Tidwell (916) 445-4521
Plant Pathologist
Analysis and Identification
Department of Food and Agriculture
1220 N Street, Room 340
Sacramento, California 94271-0001

James R. Tischer (209) 221-1388
President
The Tischer Group
1551 East Shaw Avenue, Suite 120
Fresno, California 93710

Bill Verdegaal (209) 582-9205
13821 Lacey Boulevard
Hanford, California 93230

David Wakefield (209) 698-5186
33578 West Dinuba
Cantua Creek, California 93608

Carol Watson (602) 621-7962
Environmental Research Lab
2601 East Airport Drive
Tucson, Arizona 85706-6985

Way Farms (805) 764-5264
Rich Wegis
Richard Young
Route 1, Box 161
Buttonwillow, California 93206

Dennis Westcot (916) 361-5688
Central Valley Regional Water
Quality Control Board
3443 Routier Road
Sacramento, California 95827-3098

Tolbert Williams (805) 764-5543
317 Sundan Avenue
Buttonwillow, California 93206

Roy Woodward (916) 758-2832
Sequoia Research Laboratory
P. O. Box 1802
Davis, California 95616

David Woolley (209) 655-3221
Murrieta Farms
5854 South San Diego Avenue
Mendota, California 93640

Lin Wu
Associate Professor
Department of Environmental Horticulture
University of California
Davis, California 95616
(916) 752-7179

Mr. George Zappettini
17844 Yosemite Road
Sonora, California 95370
(209) 928-3468

SECTION 12.0

Glossary

12.0 Glossary

AGROFORESTRY: A concept which uses tree plantings to support the production of farm crops through improved water management and reduced soil erosion. The trees also increase the production and marketing options for farmers.

BIOFILTER: Plants which accumulate selenium and salts and which may be grown for the purpose of partial removal of these elements from a farming system.

BIOMASS: Crops and trees grown and harvested as industrial or energy commodities.

COPPICE: The regrowth of trees from stumps after cutting.

CUTTINGS: Portion of a stem, root, or leaf cut from the parent plant for the production of a new independent plant by inducing it to form shoots and roots under favorable environmental conditions.

DEFOLIANTS: Agricultural chemicals applied for removing foliage from plants (e.g., defoliants applied before cotton harvesting).

DESALINIZATION PLANT: A water treatment facility which uses industrial technology for removing salts from water.

ELECTRICAL CONDUCTIVITY (EC): One way of measuring salinity of water or soils, commonly expressed as millimhos per centimeter (mmhos/cm) or deciSiemens per meter (dS/m), equivalent terms. EC can also be related to osmotic pressure, which influences the amount of water a plant's roots can extract from the soil. One mmhos/cm or dS/m corresponds to about 640 parts per million total dissolved solids (see ppm, TDS).

EVAPOTRANSPIRATION (ET): The quantity of water transpired and evaporated from plant tissues and the surrounding soil surface. Quantitatively, it is expressed in terms of volume of water per unit area over a specified period of time (i.e., acre-feet per acre per year) or depth of water during a specified period of time (i.e., meters per year).

GYPSUM: Calcium containing soil amendment applied to soils with a high concentration of sodium. The calcium replaces sodium on soil particles so that the sodium may be leached below the root zone.

HALOPHYTE: A plant with high salinity tolerance which may uptake salts and can be irrigated with highly saline water.

LEACHING: The application of sufficient amounts of excess water to a field in order to flush out salts.

LEACHING REQUIREMENT: The amount of water required to flush a sufficient quantity of salts from the root zone to maintain full crop productivity.

PARTS PER MILLION (ppm): Equal to one part of a substance dissolved in one million parts of a solution. Nearly equivalent to milligrams per liter.

PERCHED WATER TABLE: Ground water supported by a zone of material of low permeability and situated above an underlying main body of ground water with which it is not hydrostatically connected.

PERCOLATION: Movement of water down through the soil toward the water table (the level at which water stands in a well).

SALINE SINK: A body of water or soil too salty for crop production.

SALINE SOIL: A soil high in soluble salts but without too much exchangeable sodium.

SALINE-SODIC SOIL: A soil which has both high soluble salt and sodium levels.

SALT BALANCE: Equilibrium achieved when the amount of salt entering an area (through irrigation) equals the amount of salt leaving (through leaching the root zone)

SEEDLING: Young plant originating from seed.

SEED SOURCE: A plant or geographical location from which seeds are obtained.

SEEPAGE: The gradual movement of water through the soil; usually refers to canal or ditch banks.

SELENIUM: Non-metallic trace element which is a necessary nutrient in very small amounts but can be toxic in high doses.

SODIC SOIL: A soil high in sodium but low in soluble salts.

SODIUM ABSORPTION RATIO (SAR): Ratio which indicates the relative activity of sodium ions as they react with clay. It can be determined by using the following equation:

$$SAR = \frac{Na}{\frac{\sqrt{Ca + Mg}}{2}}$$

SOIL AMENDMENT: A substance mixed into the soil to improve its properties. Usually applied to materials used to improve physical conditions.

SUBSURFACE DRAINAGE WATER: Water from perched water tables which has been removed by underground "tiles" or drainage systems.

TOTAL DISSOLVED SOLIDS (TDS): Measure of salts dissolved in water.

VALUE-ADDED PRODUCTS: Commodities processed from raw farm products which have a higher market value.

Credits

Many people contributed to the San Joaquin Valley Agroforestry Demonstration Program and to the development of this report. The major contributors are identified below:

Program Administration/ Data Coordination & Analysis	Vashek Cervinka	CDFA
	Ilona Rice	CDFA
Field Trial Management	Clarence Finch	USDA-SCS
	John Beyer	USDA-SCS
	Frank Menezes	USDA-SCS
	Raul Ramirez	USDA-SCS
Tree Selection and Propagation Project	Roy Woodward	UC Davis
	Roy Sachs	UC Davis
	Miles Merwin	ITCI
Economic and Marketing Study	Luanne Lohr	UC Davis
Wildlife Study	Andrew Dyer	CSU Fresno
	David Chesemore	CSU Fresno
Halophyte Biofilter Trial	Carol Watson	UA Tuscon

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